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LINGUISTIC STUDIES OFFERED TO JOSEPH GREENBERG

edited by Alphonse Juilland

SECOND VOLUME: PHONOLOGY

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STUDIA LINGUISTICA ET PHILOLOGICA

editor

ALPHONSE JUILLAND

Stanford University

VOLUME 4

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A.M. DEVINE *and* LAURENCE D. STEPHENS

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SECOND VOLUME

PHONOLOGY

Iosepho Greenberg,
viro imprimis docto atque humano, qui proprietates omnium linguarum communes summo studio, perspicacitate eximia penitus indagavit, hunc librum dedicamus
amici, discipuli, collegae

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The PIE Aspirates: Phonetic and Typological Factors in Reconstruction

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In the 'classical' reconstruction of the Proto-Indo-European phonological system a tetradic plosive series is assumed for each place of articulation, e.g. for the dentals **t, d, th, dh,* the members of the series being binarily differentiated along the two parameters of voice and aspiration. But already in his *Grundriss* of 1886 Brugmann had noted (p. 336) the relative infrequency of the voiceless aspirated class (**th* etc.) and had commented on the difficulty of establishing regular sound-laws for their treatment in the individual languages. He observed in particular that they were most commonly represented as a distinct class in Indo-Iranian,[1] e.g. Skt. *path-*, Av. *paϑ-* 'path'; but that in many cases (1886:352) they appeared to originate within this branch rather than derive from PIE, since other languages showed unaspirated cognates: e.g. (1886:406f.) Gk. *πάτος* = Skt. *path-*, *ἔστη* = *asthāt*, as against *οἶσθα* = *vettha* with aspiration also in Greek; and even within Iranian one finds variation as between Av. nom. sing. *pantā̊* (cf. Gk. *πόντος*) and gen. sing. *paϑō*. The tetradic system has been fully preserved in most modern Indo-Aryan languages, and the frequency of occurrence of the voiceless aspirates increased by Middle Indian sound-changes, as e.g. in Skt. *hasta-* → Pkt. *hattha-* → Hindi *hāth*.[2]

As early as 1891 de Saussure had suggested that certain cases of Skt. *th* might derive from a sequence **tə* (cf. Szemerényi 1973:8ff.). This idea was taken up in 1926 by Pedersen, who derived all the voiceless aspirates from **tə̯* etc. (with consonantal 'schwa'), and suggested that occasionally voiced aspirates could have a similar origin (Szemerényi 1973:13ff.), as had earlier (1912) been proposed by Cuny[3] (cf. Skt. *aham, mahi* beside Gk. *ἐγών, μέγα*). Similar views have since been adopted by Kuryłowicz and Benveniste, though the latter restricts the development of aspirated plosives from plosive + 'laryngeal' to the voiceless class (with **ə̥$_2$/H_2*); and Sturtevant (1942:85) suggested that voiceless aspirates could also arise from voiced plosives + voiceless laryngeal.[4]

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[1] Approximate percentages for Sanskrit (Whitney 1889:26) are: voiceless unasp. 60; voiced unasp. 25; voiced asp. 10.5; voiceless asp. 4.5.

[2] In Hindi the voiceless aspirates represent around 8.5% of the plosives (cf. Ghatage 1964:213).

[3] Cf. also later Sturtevant 1941.

These hypotheses could explain the variation in Av. *pantā̊* ~ *paϑō* as deriving from **ponteH* ~ *pn̥tHos* (cf. Sturtevant 1941:10), and the difference between invariable aspiration in Skt. *panthāḥ, pathaḥ* and invariable non-aspiration in Gk. *πόντος, πάτος* as due to the operation of converse analogical levellings. The same would apply to the contrast between Skt. *asthāt, tiṣṭhate* and Gk. *ἔστη, ἵσταται*, the derivations being from original **steH-* ~ *stHe-* (cf. Lehmann 1952:80).

It has thus come to be a widely held view that the PIE plosive system was triadic and not tetradic, i.e. that it comprised only the series **t, d, dh* etc., and that *th* was a later, language-specific development deriving from **tH* etc. (plosive + laryngeal);[5] and the development of /th/ etc. as independent phonemes in Indo-Iranian has been seen by some scholars as dependent upon the emergence of voiceless allophones of /dh/ etc., notably in the position after /s/: thus Kuryłowicz (1935:51, 1973a:68); Villar (1971), (cf. also Siebs 1904:294ff.).

Objections have, however, been raised to such a triadic reconstruction on the grounds that it is typologically suspect: for "no language adds to the pair /t/ — /d/ a voiced aspirate /d^h/ without having its voiceless counterpart /t^h/" (Jakobson 1958:23),[6] and "the surmised coexistence of a phoneme 'aspirated stop' and a group of two phonemes — 'stop' + /h/ or another 'laryngeal consonant' — is very doubtful in the light of phonological typology" (cf. also Szemerényi 1962:9; 1967:88ff.; 1970:135f.). This argument, if valid, is certainly very damaging to the hypothesis of a triadic series plus combinations of the type **tH*. But it may not be quite as strong as it appears.

Firstly, in Sanskrit there exists a phoneme /h/, deriving from PIE voiced aspirates, and this is unanimously described by the ancient phoneticians as a voiced [ɦ]; thus e.g. the *Ṛk-Prātiśākhya* (xiii.4-6):

> Breath is emitted for the voiceless sounds and voice for the others, except for

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[4] For a survey see Messing 1947:184ff.; and for more recent work (including Hiersche 1964, not available to me) Villar 1971.

[5] Christol (1972) suggests that in prehistoric Greek /th/ was still diphonemic, and became monophonemic only as a result of the loss of intervocalic *h* (< **s*) and initial psilosis (on which, however, Christol's chronology is idiosyncratic).

[6] Cf. also the statement by Szemerényi (1962:10) that, if PIE had a voiced 'laryngeal', then "there must have been a corresponding voiceless phoneme".

> the voiced fricative and voiced aspirates (*soṣmoṣmaṇāṃ ghoṣiṇām*), where both breath and voice are emitted;

and elsewhere the same treatise condemns as a fault in the pronunciation of /h/ "excessive breath or similarity to a voiceless sound" (xiv.28). The sandhi rules also unequivocally point to a voiced sound, since preceding plosives are regularly voiced before it: e.g. *tat* + *hi* → *taddhi*. Yet there is no voiceless phoneme corresponding to this voiced /h/; a voiceless breathing (the 'visarga', transcribed *ḥ*) does indeed occur, but it has no phonemic status and is only a terminal variant of /s/ or /r/; it is not included in the Pāṇinian 'alphabet' (*varṇa-samāmnāya*) and is described by the *Pāṇinīya-Śikṣā* as 'dependent' (*parāśraya*);[7] and the distribution of *h* and *ḥ* is such that they are never in opposition.

Secondly, in Abaza (N.W.Caucasus) there are voiceless aspirated plosives, but also quite distinct sequences of plosive (or affricate) + pharyngal fricative (voiceless or voiced, plain or labialized — *ħ*, ʕ, *ħ*ʷ, ʕʷ): e.g. /t*ħ*ámada/ 'symposiarch', /p*ħ*ʷes/ 'woman', /c*ħ*a/ 'bridge', /čʷ*ħ*a-/ 'curse, /čʷ*ħ*ʷa-/ 'blow', /pʕa-/ 'capture for marriage', /čʕʷa/ 'hearth' — beside e.g. /tʰaqʰ-/ 'want', /pʰa/ 'son', /cʰa-/ 'go', /čʰə/ 'horse', /čʷʰa/ 'hay'.[8] It could admittedly be argued that the aspiration of /tʰ/ etc. is not a distinctive feature, since the unaspirated /t/ etc. are characterized by glottalization, which could therefore be considered as the feature differentiating the two types of voiceless plosive (as is suggested by the Russian-based orthography — e.g. т = aspirated, тı = glottalized; cf. also Gamkrelidze and Ivanov 1973:155): but on the other hand the glottalization is relatively weak, and my informant, who was not literate in his native language, consistently described the glottalized and not the aspirated class as 'ordinary',[9] i.e. unmarked.

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[7] Cf. Fry (1941); Allen (1953:16f., 50f.; 1962:57, 70, 77f.).

[8] There is a cognate typological argument that "as a rule, languages possessing the pairs voiced — voiceless, aspirate — non-aspirate, have also a phoneme /h/" (Jakobson 1958:23): this is, however, not true e.g. of psilotic dialects of ancient Greek. Szemerényi's further argument (1967:89f.; 1970:131f.) that the existence of PIE aspirated plosives implies the existence of a phoneme /h/ and that, if this corresponds to a hypothetical 'laryngeal', the latter must be simply a glottal fricative and not a pharyngal, also loses some of its force in the light of the Abaza data, since Abaza has pharyngal but no glottal fricatives.

[9] A similar description ('*māmūlī*') was given by my principal Marwari informant of the voiced glottalized (implosive) stops in that language: on the writing system cf. Allen 1957:7 n.3 and refs.

In Georgian, which, like Abaza, has an opposition aspirated : glottalized, the latter are generally called *mk'vetri* 'sharp'; but it is remarkable that in the uvular series only the glottalized member survives in most of the modern dialects, the aspirated member (of Old Georgian) having developed to a fricative. In Abaza similarly, the glottalized palatalized uvular /qʸ'/ occurs but not the aspirated /qʸʰ/: cf. Genko 1955:22; Allen 1956:129 n. 3 (with further refs.). These facts would tend to suggest that it is the aspirated rather than the glottalized that is the 'marked' member in this series (cf. Greenberg 1966:17f.).

In criticizing the triadic system from a typological point of view, Szemerényi (1967:89) makes the point that, if we do set up such a system, "what we cannot do is to go on using these symbols as if we really meant voiced aspirated stops when we use the symbol /dh/". And some other writers, convinced on the one hand of the non-existence of PIE **th* etc., and on the other of the typological unacceptability of a system **t, d, dh*, have attempted to salvage the situation by redefining **dh* etc. as something other than voiced aspirates. Kuryłowicz (1973a:68; 1973b; cf. also Villar 1971) suggests that in such a system the opposition **t:dh* involved only a single feature — aspiration, i.e. that in the absence of a voiceless aspirate **dh* was neither distinctively voiced nor voiceless; it might have been *phonetically* voiced, but this would be of no phonological consequence — rather like the inherent voicing of liquids and nasals in many languages; only with the emergence of a voiceless class, in Indo-Iranian, would **dh* etc. have acquired distinctive, phonemic voicing. I confess to an uneasy feeling that, in spite of its attractiveness, this solution is really a piece of sleight-of-hand. In languages where, as most commonly, there is no contrast between voiced and voiceless liquids and nasals, these are normally voiced; but this fact is surely related to their particular 'sonorant' quality, which in turn is linked to their non-obstruent articulation, permitting (as an 'unmarked' characteristic) an outflow of breath sufficient to vibrate the vocal cords, rather as in the case of vowels (cf. Allen 1973: 69f. and refs.). No such consideration applies to plosives, and the parallel does not therefore seem a valid one.[10]

A phonetically based approach to the dilemma is adopted by Hopper (1973), who suggests that **dh* etc. were 'murmured' stops (and **d* etc. glottalized). He also states (pp. 147f.) that in any case there could be no such thing as a voiced aspirate, since aspiration implies delay in glottal onset. A similar attitude is taken by Lass (1974:52ff.) in connexion with Grimm's Law, citing the descriptions of the 'voiced aspirates' in modern Indian languages by a number of phoneticians (Ladefoged, Catford, Pandit, Lisker and Abramson, Ohala and Ohala). First, however, let us consider the description of these sounds by the ancient native phoneticians. The aspiration feature in these accounts is identified with the voiced *h* discussed above; having stated that "when the glottis closed, voice is produced; when it is open, breath" (e.g. *Taittirīya-Prāt.* ii.4-5; cf. Allen 1953:34), they go on to say (as *Ṛk-Prāt.* xiii.2) that "when the glottis is in an intermediate state both breath and voice are produced", and this condition is attributed to *h* and the "voiced aspirates". These descriptions were not well received by 19th-century Sanskritists: for Max Müller, in his edition of the *Ṛk-Prāt.* (710), "Dies ist eine indische Vorstellung, welche wohl nicht zu rechtfertigen ist"; and Whitney, in his editions of the *Atharva-Prāt.* (i.13) and *Tait.-Prāt.* (ii.6), comments:

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[10] The non-distinctiveness of the voicing in liquids and nasals is indicated in some languages by the fact that, unlike voiced plosives, they do not have an assimilatory effect (in respect of voice) on preceding consonants; in Sanskrit, for example, voiceless *s* remains in *tisraḥ, asmi*, but → **z* in e.g. *edhi* < **azdhi* (cf. Av. *zdī*); similarly e.g. *k* in *śaknoti* beside *g* in *śagdhi*.

> I confess myself unable to derive any distinct idea from this description, knowing no intermediate utterance between breath and sound . . . That intonated and unintonated breath should be emitted from the same throat at once is physically impossible.

But more recent descriptions tend to support the ancient phoneticians, e.g. Westermann and Ward (1949:86):

> A voiced *h* can be made. For this sound the vocal cords vibrate along a considerable part of their length, while a triangular opening allows the air to escape with some friction.

— a description which is quite compatible with the 'intermediate condition' of the Indian writers. More physiological detail is given in Ladefoged's description of the 'voiced aspirates' in Gujarati, cited by Lass (1974:52), as having an

> adjustment of the vocal cords in which the posterior portions (between the arytenoid cartilages) are held apart, while the ligamental parts are allowed to vibrate . . . There is a high rate of flow of air out of the lungs during these sounds; so the term breathy voice is also appropriate.

But, relevantly to Lass's argument, Ladefoged goes on to describe these consonants as having a 'murmured release':

> There is, it is true, an extra puff of air accompanying both the voiceless aspirated and the murmured stops; but this puff of air is produced in a different way in each case so that the release of one sounds quite different from the other . . . when one uses a term such as voiced aspirated, one is using neither the term voiced nor the term aspirated in the same way as in the description of the other stops.

Lass himself (1974:54f.) observes a lowering of the glottis during the closure phase of these sounds, and proposes a characterization of them involving a conjunction of this feature (together with a related arytenoidal separation) and of glottal pulsing (i.e. voice), whereas (p. 53) voiceless aspiration "is most probably a matter of sequential control of voicing onset".

It may be readily admitted that the phonetic details associated with the 'voiced aspirates' are different from those associated with voiceless aspirates. But this does not necessarily mean that the feature 'aspiration' is not applicable to both of them; for it is only to be expected that the manifestations of this feature, involving the glottis as it does, would be somewhat different in association with voiced and voiceless sounds. If, for example, delay of voicing is a characteristic of the voiceless aspirates, giving rise to a period of voiceless breath, the same delay in the case of voiced aspirates may be expected to give rise to a period of voiced breath: partial glottal closure is needed to provide the feature of voice (which is maintained from the consonant articulation to the vowel), so that only partial (arytenoidal) opening is available for the feature of aspiration, i.e delay in the onset of full (non-breathy) voicing. Diagrammatically the glottal differences may be illustrated as follows (+ = closed, O = open):

	C	h	V
Voiceless asp.	O	O	+
Voiced asp.	+	⊕	+

There is no evidence that glottal delay is the primary factor in the voiceless aspirates rather than an inevitable secondary effect of aspiration after a voiceless articulation.

In both cases the articulatory posture for the following vowel is prepared during the aspiration phase, giving rise in the one case to some voiceless anticipation of the vowel and in the other to breathy voiced anticipation: one is reminded of the statement of the *Taitt.-Prāt.* (ii.46-8; cf. Allen 1953:49):

> For [voiced] *h* and [voiceless] *ḥ* the glottis is the place of articulation; but in the opinion of some authorities *h* [which never occurs finally] is homorganic with the beginning of the following vowel, and *ḥ* [which only occurs finally] is homorganic with the end of the preceding vowel.

All the other phonetic peculiarities of the voiced aspirates could equally well be related to combination with the feature of voice[11] —just as quite wide allophonic differences can be attributable to different environments. For a parallel in feature terms one could point to labialization in a language like Abaza or in some African languages, which takes on markedly different forms with velar or uvular articulations and with prepalatal articulations, and very different forms again in combination with dentals as in Abkhaz or Ubykh (see e.g. (on Chwana, Gã, and Twi)

[11] Including pitch characteristics of the following vowel, as in the Panjabi or Lahnda reflexes of the Sanskrit voiced aspirates (cf. Allen 1951:135 and refs.; Lass 1974:54), or in the Eastern Armenian reflexes of the PIE voiced aspirates (where the vowel is articulated with markedly stronger breath-force and on a lower pitch than in other contexts: Allen 1950:200): for actual voiced aspirates in some Armenian dialects see refs. in Allen 1951:134f. and especially Adjarian 1909:3, 49.

Westermann and Ward 1949:104f.; (on Abaza) Genko 1955:39, 48, 51f.; (on Ubykh) Vogt 1963:15ff.). One may note also the realization of aspiration as affrication in the case of the Sanskrit palatal *ch* (cf. Allen 1953:38f.; 1962:85, 92, 109ff.), a peculiarity entirely attributable to the conformation of the tongue in this articulation.[12]

There is also strong historical phonological evidence that the aspiration of the voiced and voiceless aspirates in Indo-Aryan was one and the same feature. Grassmann's Law (of the 'dissimilation of aspirates') applies to both the voiceless and the voiced series, as e.g. in reduplicated forms like *cakhāna, jaghāna*; and it seems also to have applied even between voiced and voiceless aspirates in the same word, as in *kumbha-* < **khumbha-* (cf. Av. *xumba-*). In Greek the law applies only to voiceless aspirates, since the PIE voiced aspirates were devoiced in that language. But, contrary to traditional teaching, generative phonologists in recent years have tended to reject the doctrine that the Greek and Indian 'laws' are of separate and independent origin. The traditional crux has been that in Greek the rule seems to have applied after the devoicing of aspirates (e.g. *τέϑηκα*, not *δέϑηκα*) and after the change of **s* to *h* (e.g. ἔχω beside ἕξω, ἔσχον)[13] — neither of which changes occurs in Sanskrit, thus indicating that the dissimilation did not occur during a period of Indo-Greek unity. The 'rediscovery' of Grassmann's Law by the generative phonologists has provided them with a field-day for the strategic deployment of rule-ordering and restructuring devices in the two languages, with which we need not here be concerned.[14] But if the similarity between the two laws is felt to be too great for it to be coincidental,[15] there is one hypothesis which, if Ruijgh is wrong (see n. 13), could be called in to explain it — that of 'phonological affinity' between otherwise divergent languages which have remained in or come into geographical contact. This hypothesis would assume that Sanskrit and Greek had diverged to the extent, inter alia, of

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[12] Note also the further development in E.Bengali dialects, where *ch* → (fricative) [s], beside *c* → (affricate) [ts]: Ferguson and Chowdhury 1960:35.

[13] Ruijgh (1967:44f.) has even suggested that the law is later than the Mycenaean tablets.

[14] A useful bibliography may be found in Miller 1974.

[15] This, however, is not necessarily the case. For example, the Greek change of **s* to *h*, as also the development **tt* → *st*, is shared by Iranian, and could reflect a common development (for discussion of the former see Gusmani 1972). But the Iranian change of voiceless aspirates to fricatives, and of other plosives to fricatives before plosives (e.g. Av. *safəm, uxta-* = Skt. *śapham, ukta-*), though both paralleled in Greek, there occur only at a very late period (cf. Mod. Gk. /fílos/, /oxtó/ etc.). The latter changes, therefore, must be quite independent. One's judgment in these matters often depends on how specialized the shared innovations are; the Greek and Sanskrit versions of Grassmann's Law are admittedly strikingly similar in detail: but, as the next paragraph shows, dissimilation of aspiration in some form can also occur quite independently.

Greek devoicing the voiced aspirates and making the change of **s* to *h*;[16] but that they had remained in contact to the extent that a 'wave' of aspirate-dissimilation with its epicentre in one or other language-area could spread across into the other:[17] the situation could be depicted in one of Southworth's modified family-tree diagrams (1964) by representing the specifically Greek changes in question as 'non-definitive'. If this was in fact the situation, then it would imply that 'aspiration' was the same phonological feature whether it was voiceless as in Greek or voiced as more generally in Sanskrit (cf. also Kiparsky 1973:127f.).

There is also the particularly striking case of a latter-day 'Grassmann's Law' which operates in the Hāṛautī dialect of Rajasthani[18] (spoken in the Koṭā division of Rajasthan). The historical processes involved are as follows:

(i) An aspirated consonant (or *h*), if preceded by an aspirated consonant (or *h*), at any distance within the word, loses its aspiration (*h* → zero);
(ii) An aspirated consonant (or *h*), if preceded by a voiceless unaspirated plosive, at any distance within the word, transfers its aspiration to that plosive;
(iii) A non-initial voiced aspirated consonant (or *h*) loses its aspiration (*h* → zero). This change operates after (ii).

Examples of the results of these processes are listed below, with cognate Hindi forms in parentheses to provide the historical controls:

(i) *bhīk* 'alms' (*bhīkh*); *laphāpo* 'envelope' (*liphāphā*); *hātī* 'elephant' (*hāthī*).
(ii) *khāto* 'catechu' (*katthā*); *khāṃdo* 'shoulder' (*kaṃdhā*); *chə̄ro* 'face' (*cehrā*).
(iii) *gaḍ* 'fort' (*gaṛh*); *bū* 'wife' (*bahū*).

Voiced aspiration is here in a sense 'recessive' as compared with voiceless aspiration in that, whilst voiced aspirated consonants (and *h*) may *retain* their aspiration (initially) and *inhibit* subsequent aspiration, voiced unaspirated consonants never *receive* aspiration[19] and non-initial voiced aspirated consonants (and *h*) always either *transfer* their aspiration or simply *lose* it. But the relevant fact for our present argument is that aspiration can be transferred from a voiced consonant as well as from a voiceless consonant to a voiceless consonant (as in *khāṃdo*); and a voiced aspirated consonant as well as a voiceless can cause deaspiration of a voiceless consonant (as in *bhīk*). There could hardly be stronger evidence that, in this dialect at least, aspiration whether voiced or voiceless was one and the same feature.

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[16] Safarewicz (1972) connects the devoicing with this change.

[17] Note also the fact that Greek and Indo-Iranian share the development of syllabic nasals to a simple vowel *a* (also dialectally *o* in Greek), although in Greek the change is probably later than that of **s* → *h*: cf. Thieme (1958:513); Kiparsky (1973:127 n.8). In respect of the changes mentioned in note 15, Greek is more closely connected with Iranian than with Indian: but this need not be an objection to the hypothesis, since, as a result of the Iranian deaspiration of voiced aspirates (and fricativization of voiceless aspirates), the dissimilation rule was there simply not relevant.

[18] For a summary of the facts see Allen (1957:5f.).

An aspect of these rules which deserves mention in passing is the fact that *h* throughout behaves in the same way as the voiced aspirated consonants: yet the surviving (initial) *h* of Harauti, as generally in the modern languages, is voiceless. And in addition, though not so far mentioned, *s* has the same inhibiting effect as an aspirated consonant or *h*: thus e.g. *sātī* 'companion' (= Hindi *sāthī*). The remarkable thing is that in some *other* Rajasthani dialects (N.W.Mārwāṛī and S.Mewāṛī; Allen 1957:6) *s* → voiceless [h][20] and *h* → voiced [ɦ]: thus e.g. Mar. *hīro* 'sweetmeat' (= Har. *siro*, Hin. *sīrā*) beside *ɦīro* 'diamond' (= Har. *hīro*, Hin. *hīrā*); *hū go* 'went to sleep' (= Har. *so gyo*) beside *ɦū go* 'became' (= Har. *ho gyo*). What has happened is that in Harauti certain processes of loss, inhibition, and transfer of aspiration (which incidentally do *not* apply to the other dialects), have operated just as if the Marwari-Mewari changes had taken place in Harauti also. It unfortunately seems doubtful whether the dialect will survive the inroads of Hindi and 'standard' Rajasthani sufficiently long to demonstrate whether the processes in question have in fact 'anticipated' a future state of the language.[21]

The conclusions of this study are as follows. If **th* etc. are excluded from the PIE system (which there are at least arguable grounds for doing), the remaining triadic series **t, d, dh* is admittedly typologically exceptional, assuming that **dh* is interpreted as a voiced aspirate. But there seem no good reasons for interpreting it in any other way. Like uneven distributions of phonemes (cf. Hoenigswald 1960:80f.), typological oddities are an occasional untidy fact of life — though they tend like the former to be brought into line by subsequent changes. In this case, for example, Greek removes the oddity by devoicing the voiced aspirates, and Indo-Iranian creates for them a voiceless counterpart. The history of Sanskrit *h* shows a similar progression: as a voiced *h* it was exceptional, and in Sanskrit itself the limited development of 'visarga' (*ḥ*) did not suffice to remedy the situation; later, as in the modern languages, the oddity was removed by devoicing; and when in some of the dialects a new voiced *h* is developed, it is only in conjunction with the emergence of a voiceless replacement.

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[19] See examples in (iii) and note e.g. *gokho* 'alcove' (= Hindi *gokhā*), not *ghoko*.

[20] For a native account of this change cf. Lāḷas 1954:14; 1956.

[21] The Census of 1961 showed a decline in speakers of 25% over 1951 (my own fieldwork was carried out in 1952); and provisional figures for the 1971 Census (334,000) show a further decline of 40%.

Adjarian, H. 1909. *Classification des dialectes arméniens*. Paris.

Allen, W.S. 1950. "Notes on the phonetics of an Eastern Armenian speaker". *Transactions of the Philological Society* 180-206.

Allen, W.S. 1951. "Phonetics and Comparative Linguistics". *Archivum Linguisticum* 3.126-36.

Allen, W.S. 1953. *Phonetics in Ancient India*. (London Oriental Series, 1). Oxford.

Allen, W.S. 1956. "Structure and system in the Abaza verbal complex". *Transactions of the Philological Society* 127-76.

Allen, W.S. 1957. "Some phonological characteristics of Rajasthani". *Bulletin of the School of Oriental and African Studies* 20 (In Honour of Sir Ralph Turner).5-11.

Allen, W.S.1962. *Sandhi*. (Janua Linguarum, series minor 17). The Hague.

Allen, W.S. 1973. *Accent and Rhythm*. Cambridge.

Brugmann, K. 1886. *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen* (ed. 1). Strassburg.

Christol, A. 1972. "Phonologie des aspirées grecques et parfait à aspirée". *Bulletin de la Société de Linguistique de Paris* 67.69-83.

Ferguson, C.A. and M. Chowdhury. 1960. "The phonemes of Bengali". *Language* 36.22-59.

Fry, A.H. 1941. "A phonemic interpretation of Visarga". *Language* 17.194-200.

Gamkrelidze, T. and V. Ivanov. 1973. "Sprachtypologie und die Rekonstruktion der gemeinindogermanischen Verschlüsse". *Phonetica* 27.150-156.

Genko, A.N. 1955. *Abazinskij jazyk*. Moscow.

Ghatage, A.M. 1964. *Phonemic and Morphemic Frequencies in Hindi*. (Poona University and Deccan College Publications in Linguistics). Poona.

Greenberg, J.H. 1966. *Language Universals with Special Reference to Feature Hierarchies*. (Janua Linguarum, series minor 59). The Hague.

Gusmani, R. 1972. "A proposito del passaggio *s* > *h* in iranico, greco, ecc.". *Archivio Glottologico Italiano* 57.10-23.

Hiersche, R. 1964. *Untersuchungen zur Frage der Tenues Aspiratae im Indogermanischen*. Wiesbaden.

Hoenigswald, H.M. 1960. *Language Change and Linguistic Reconstruction*. Chicago.

Hopper, P.J. 1973. "Glottalized and murmured occlusives in Indo-European". *Glossa* 7.141-66.

Jakobson, R. 1958. "Typological studies and their contribution to historical comparative linguistics". *Proceedings of the eighth International Congress of Linguists (Oslo 1957)* 17-35 (reprinted in Jakobson, *Selected Writings* I.523-31. The Hague 1962.

Kiparsky, P. 1973. "On comparative linguistics: the case of Grassmann's Law"; in Sebeok (ed.) 1973, 115-134.

Kuryłowicz, J. 1935. *Études indoeuropéennes* I. Krakow.

Kuryłowicz, J. 1973a. "Internal reconstruction"; in Sebeok (ed.) 1973, 63-92.

Kuryłowicz, J. 1973b. "Phonologisches zum Problem der idg. stimmlosen Aspiraten". *Bulletin de la Société Polonaise de Linguistique* 31.3ff.

Lāḷas, S. 1954. *Rājasthānī Vyākaraṇ* ('Rajasthani Grammar': in Mārwārī). Jodhpur.

Lāḷas, S. 1956. "Dialects of Jodhpur Division" (in Hindi). *Marū-bhāratī* ('Desert Speech': Pilani) iv.3, 62-7.

Lass, R. 1974. "Strategic design as the motivation for a sound shift: the rationale of Grimm's Law". *Acta Linguistica Hafniensia* 15.51-66.

Lehmann, W.P. 1952. *Proto-Indo-European Phonology*. Austin.

Messing, G.M. 1947. "Selected studies in Indo-European phonology". *Harvard Studies in Classical Philology* 56-7.161-232.

Miller, D.G. 1974. "Some problems in formulating aspiration and deaspiration rules in Ancient Greek". *Glossa* 8.211-32.

Ruijgh, C.J. 1967. *Études sur la grammaire et le vocabulaire du grec mycénien*. Amsterdam.

Safarewicz, J. 1972. "Note sur l'évolution des occlusives aspirées en grec". *Eos* 60.103f.

Sebeok, T.A. (ed.). 1973. *Current Trends in Linguistics* 11 (Diachronic, Areal, and Typological Linguistics). The Hague.

Siebs, T. 1904. "Anlautstudien". *Zeitschrift für vergleichende Sprachforschung* 37.277-324.

Southworth, F.C. 1964. "Family-tree diagrams". *Language* 40.557-56.

Sturtevant, E.H. 1941. "The Indo-European voiceless aspirates". *Language* 17.1-11.

Sturtevant, E.H. 1942. *The Indo-Hittite Laryngeals*. Baltimore.

Szemerényi, O.J.L. 1962. *Trends and Tasks in Comparative Philology* (inaugural lecture). London.

Szemerényi, O.J.L. 1967. "The new look of Indo-European: Reconstruction and Typology". *Phonetica* 17.65-99.

Szemerényi, O.J.L. 1970. *Einführung in die vergleichende Sprachwissenschaft*. Darmstadt.

Szemerényi, O.J.L. 1973. "La théorie des laryngales de Saussure à Kuryłowicz et à Benveniste. Essai de réévaluation". *Bulletin de la Société de Linguistique de Paris* 68.1-25.

Thieme, P. 1958. Review of A. Carnoy, *Dictionnaire étymologique du proto-indo-européen. Language* 34.510-15.

Villar, F. 1971. "El problema de las sordas aspiradas indo-europeas". *Revista Española de Lingüística* 1.129-160.

Vogt, H. 1963. *Dictionnaire de la langue Oubykh*. Oslo.

Westermann, D. and I.C. Ward. 1949. *Practical Phonetics for Students of African Languages* (2nd imp.). Oxford.

Whitney, W.D. 1889. *Sanskrit Grammar*. Cambridge, Mass.

The Distributional Syllable*

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1. Introduction

In "Is the vowel-consonant dichotomy universal?" Joseph Greenberg (1962) constructs a rigorous, explicit procedure for determining the syllabic and nonsyllabic segments of a language solely on the basis of their distributional properties. A number of other scholars also saw the possibility of general definition of the syllable in its evidently close relationship with segment distribution — Kuryłowicz (1948), O'Connor and Trim (1953), Haugen (1956a, b), and Pulgram (1969).

They held in common two basic assumptions about the syllable's nature. First, the syllable is not an independent unit, but is to be derived from segmental properties. Second, the syllable should be defined formally, without reference to phonetic realization, in terms of the distributional properties of segments. Let us thus call the unit so defined the distributional syllable.

The definitions of the distributional syllable represent a considerable achievement, whatever judgement comes to be made of their ultimate success. A comment of Noam Chomsky's applies here, although it was originally directed at another of Greenberg's formalizations, "The definition of linguistic units" in *Essays in Linguistics*:

> If rigorous procedures can in fact be found, such attempts at rigorous statement are the only way to find them. If not, these attempts will still have been valuable because of the insight into language structure that results from a demonstration of the limitations of certain methods of approaching it. (1959:217).

Moreover, many of the ideas that they embody are still influential today,

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both in descriptive and theoretical research. For example, Hooper's (1973) view of the syllable, in which syllable structure conditions are stated in terms of a segmental cover feature Strength, has much in common with the theories of the distributional syllable, since distribution is taken to be the primary means of determining language-specific strength hierarchies. (Hooper does not share the two basic assumptions stated above, however).

This paper seeks a better understanding of the strengths and limitations of the ideas behind the distributional syllable. We shall be asking how well the definitions meet an essential criterion for a successful phonological theory, one which Greenberg imposed upon himself, namely reasonable conformity with the phonetic facts. Further, and equally important, what is their ability to support generalizations about phenomena beyond those for which they were specifically intended, i.e. segmental phonotactics?

2. Syllabicity

There are two parts to the definition of the syllable, syllabicity and syllabification. I take up first the problem of syllabicity, how to distinguish syllable nucleus from syllable margin.

2.1. *The procedure of O'Connor and Trim.* Pike's (1948:78) distinction between vowel and vocoid underscored a fact that linguists now commonly acknowledge: that the syllabicity of a segment cannot generally be predicted from its other phonetic features. On the other hand, a theory of the distributional syllable would maintain that the syllabic and non-syllabic segments of a language could be distinguished entirely by their formal distributional properties. O'Connor and Trim and Greenberg have proposed explicit procedures to make this hypothesis operational.

Both approaches start from the valid observation that speech segments are not strung randomly in sequence. Marginal and nuclear segments more commonly alternate than succeed each other.

The alternation of margin and nucleus is nicely exemplified by a hypothetical language with the common word canon $[CV(C)]^n$. Let us call it language A and use it to demonstrate the mechanics of the two methods.

O'Connor-Trim take the first two and the last two positions of the word as defining. In each position, they compute the number of contexts each phoneme has in common with every other phoneme. For example, say that *t* occurs before all vowels initially (*ti, te, ta, to, tu*) and *b* occurs before all except one (*bi, be, ba, bo, *bu*). Then the pair *t-b* would have four contexts in common initially.

Now let us assume that our language A has five segments in class V and

20 in class C, and that they combine freely within the limits of the canon $[CV(C)]^n$. As Table 1 shows, every pair in the class C will have, in the four positions, 5, 0, 5, and 5 contexts in common, a total of 15, or 100% of the number possible. Pairs from the class V will have 0, 20, 20, and 20 contexts in common, again 100%. But no segment in class C will have a common context with any segment in class V, although both occur in the final two positions. No other two classes of phonemes will show this pattern.

TABLE I: O'CONNOR–TRIM SYLLABICITY IN LANGUAGE A

Classes of segment pairs	Common contexts by position				Total
	Initial	Post-initial	Pre-final	Final	
C - C	5	0	5	5	100%
V - V	0	20	20	20	100%
V - C	0	0	0	0	0%

2.2. *Greenberg's procedure.* Greenberg constructs a function called the 'maximum recurrence interval' to distinguish vowel from consonant. For a given class of phonemes, the maximum recurrence interval is the length of the longest sequence of phonemes, not belonging to the class, that can separate two members of the class (or separate a member from initial or final position). The motivation behind this function is that "since the maximal length of the sum of the margins of the syllable is necessarily greater than the center, the maximal interval for . . . the recurrence of nuclei will always be larger than for the consonant class". The class of nuclei is then defined as the smallest class of segments meeting two conditions: it must have a higher maximum recurrence interval than any other class, and every sentence must contain at least one of its members. In our language A, the maximum recurrence interval for the class C is 1 (e.g. #C*V*C#), and that for the class V is 2 (e.g. #CV*CC*V#). Furthermore, V is the smallest qualifying class, for if one of its members is removed, then there will be sentences in which the new reduced class does not occur.
2.3. *Defects of the procedures: marginless syllables.* The major weakness of both procedures is that they do not yield a classification into margin and nucleus which accords with phonetic realization for certain language types where alternation of margin and nucleus is less prominent than in language A. Languages possessing syllables without margins are such a type.

These languages are necessarily difficult for the O'Connor-Trim procedure. One reason for choosing initial and final positions was to avoid counting intersyllabic contexts. This cannot be avoided, since it is certainly possible for a language to exhibit both nuclear and marginal sequences in initial and final positions. When this occurs, statistics based on common contexts of occurrence do not lead to a clear separation of margin and nucleus. I do not offer an illustration, for the reader may consult Arnold (1964), who, after unsuccessfully applying the procedure to Greek and Polish, concluded that it could only be expected to be successful for certain types of languages.

The conceptual basis for the O'Connor-Trim procedure is that distributional constraints on segments, particularly within syllables, are strongly determined by their membership in the classes of margin and nucleus, which is surely true. This concept could be implemented by finding an explicit measure of similarity of distribution between a pair of segments, and then grouping segments into two categories, called margins and nuclei, according to their similarity of distribution. The similarity between pairs of margins and the similarity between pairs of nuclei is in general assumed to be greater than the similarity between margin-nucleus pairs. A necessary condition for such a procedure to qualify as a formal definition of consonant and vowel is:

(1) There exists, for any pair of segments in a language, a universal measure of similarity of distribution that leads, by some clustering procedure, to a margin-nucleus categorization of the segments.

This implies that there is some set of universally definable contexts over which the margin-nucleus classification invariably dominates the many other segment classifications as a determiner of distributional constraints.

There is no reason to believe that (1) holds. O'Connor and Trim's only explicit claim was to have found a procedure that was successful for English. Arnold (1955-56) was able to apply it also to French. But neither the original measure nor certain modified ones were successful when Greek and Polish were included (Arnold 1964). One might wonder whether statistics based on token rather than type occurrences would be more successful. I can only say that an attempt of mine to apply this approach to English showed no promise whatsoever.

Although it has been much less influential, Greenberg's algorithm is superior in many respects to the statistical definition of O'Connor-Trim. His recurrence function is carefully constructed so that it will apply to any language, whereas the computational procedures of O'Connor-Trim are ad hoc and admittedly unsophisticated.

Greenberg's algorithm also automatically assigns the labels 'margin' and 'nucleus' to the classes it distinguishes, whereas the O'Connor-Trim procedure is only designed to distinguish two classes. They do point out that in English one class should be designated as nuclear because it is less common initially and finally, its members occur in sequence less often than those of the other class, and because some words contain only its members. However, Greenberg incorporates these tendencies of nuclear segments in a general and explicit way. Thus any difficulties encountered by his procedure may also be assumed to be a problem for more general procedures based on the O'Connor-Trim approach.

A language type for which the Greenberg procedure gives unacceptable results is illustrated by language B. Language B has no sequence of marginal segments. Sequences of syllabic nuclei occur. No words consisting only of vowels are found in language B. This type of structure can be found in Hottentot, for example (Beach 1938). Occurring words are #CV#,#CV.V#,#CVCV#,#CVC#, etc.; non-occurring are *#CCV#, *#V#, *#CVCCV#, etc.

The maximum recurrence interval for the marginal elements is 2, 3, 4, or however many syllable nuclei can occur in sequence, e.g. in #C*V.V*#. The interval for the class of nuclei is 1, e.g. in #*C*V.V#, since there are no clusters of consonants. The procedure thus assigns the formal label 'vowel' to the margins, and 'consonant' to the nuclei. The labels would similarly be reversed for a language like Guaraní, in which sequences of two consonants and up to three nuclei can occur (Gregores and Suárez 1967). It is not unreasonable to suppose that there may exist languages whose maximum sequences of margins and nuclei are of the same length, and which contain no words of vowels only, although I know of no example. In such a case, the procedure would either not distinguish two classes, or else by virtue of unrelated distributional gaps, would distinguish entirely irrelevant classes.

What happened? The overt conceptual basis for the procedure, that a syllable does not in general have fewer marginal segments than nuclear segments is sound enough, at least under the usual assumption that nuclei contain but a single syllabic segment. However, the procedure also depends crucially upon the further hypothesis,

(2) If there occur longer sequences of nuclei than sequences of margins in a language, then there will occur words composed only of nuclei.

This generalization does not hold.

2.4. *Defects of the procedures: segments which may be syllabic or not.* The treatment of segments which may be either syllabic or nonsyllabic (most commonly high vocoids or sonorants) is difficult for any formal distributional theory. If both syllabic and nonsyllabic forms are represented at the given level of analysis, then no new problems arise. But frequently the two functions do not contrast, and both have the same formal representation. How could a formal method distinguish the nuclei of a sequence in this case? It is of course possible to maintain that it is unreasonable to require of a formal method that it distinguish margin from nucleus where it is formally irrelevant. Neither Greenberg nor O'Connor and Trim accept this refuge. Greenberg states that such segments should be treated as two phonemes for the purposes of his procedure (1962:77). O'Connor-Trim explore another possibility, that such segments will exhibit contexts in common with both vowels and consonants, and that they can then be separated into two segments with appropriate distributions. Unhappily, segments in double function do not always show this pattern, and furthermore they are not the only kinds of segments that may do so. For example, in a language with no initial vowels or initial marginal clusters and a preconsonantal syllabic *n̩*, the measure of O'Connor-Trim would group *n̩* unambiguously with the consonants, revealing nothing of its double function. (Even if the syllabic segment has a separate label, if the language had no marginal sequences and no utterances with nuclei consisting solely of *n̩*, Greenberg's recurrence intervals would give the same result. The maximum recurrence interval for vowels would be 2, e.g. *#n̩CV-*. Including *n̩* with the vowels would reduce the maximum interval to 1, hence it is assigned to the consonants).

If vowels occur initially (as in a number of Bantu languages) the O'Connor-Trim measure will show a double affinity for *n̩*. But then compare this to a language where instead of initial *n*C- sequences, the only initial sequences are *s* + consonant, as in Alabaman (Rand 1968). In this case, *s* too would exhibit considerable commonality with vowels and consonants.

I think that it is fair to conclude that an explicit, non-phonetic distributional characterization of vowel and consonant is not readily available, if possible at all. Before I turn to distributional theories of syllabification, let me remark that they are not unaffected by this conclusion. Syllable division is a matter of determining which marginal elements belong to which nuclei. A theory of syllabification must becessarily presume that segments have already been classified as margin or nucleus, if only to be able to indicate that consecutive nuclei belong to different syllables. Of course, it is possible to uphold a hybrid distributional theory, granting that syllabicity has an independent or phonetic basis, but that syllable division is essentially distributional. This is the conclusion of Kloster Jensen (1963).

3. Syllabification: the Kuryłowicz Condition

The key to distributional theories of syllabification is a principle first exploited systematically by Kuryłowicz (1948), namely, that initial and final clusters of medial syllables conform to the same constraints as those in initial and final syllables. Stated formally, we have the Kuryłowicz Condition,

(3) If an intersyllabic sequence of consonants is analyzable into permissible word-initial and word-final clusters, then the syllable boundary does not fall between non-permissible clusters.

Compared to most sweeping statements about the syllable, the condition's conformity with the 'phonetic facts' is astonishingly general. Even so, it does not appear to hold universally.

Before I proceed with citation of counterexamples, the nature of the 'phonetic facts' of syllabification deserves mention. The descriptions of syllable division cited below are, to my best knowledge, based on the informed auditory judgement of trained linguists. Derivative syllable divisions postulated on the basis of sonority theories, distributional theories, etc. are not included. Judgements of syllable division in some contexts are of course notoriously treacherous (Lebrun 1966, Bell 1975), resembling those of stress levels in some respects. A competent investigator, however, will make no statement about syllable division, or qualify it, if he is unsure. It does not follow, then, that all descriptions of syllable division are invalid — rather, like all phonetic description, they have evidential value subject to challenge.

We construct language C to illustrate one type of counterexample. Language C has no initial clusters and only open syllables in final position. It has medial consonant sequences of two segments. They are all heterosyllabic — syllable division falls between the segments. Typical forms for language C would be #CVC.CV#, #CV.CV#, #VC.CV#. Now say, perhaps by vowel loss, some of the medial clusters end up occurring in initial position as well. The Kuryłowicz Condition predicts that just these clusters will become tautosyllabic, this being the only division yielding permissible initials and finals. It seems nevertheless plausible that they might retain their original syllabification. Indeed something like this appears to have occurred in Huichol, which has a few initial clusters, for example *pt-*, *pk-*, and *mt-*; no final consonants; and medial consonant sequences which include the initial ones. McIntosh (1954) and Grimes (1959) report that all medial clusters are heterosyllabic. Another language where the same process has led to a violation of the Kuryłowicz Condition is Alabaman (Rand 1968). The Alabaman initial clusters are /st, sk, sw, sL/.

This makes it less tenable that the inherent heterosyllabicity of the segment sequences explains the violation of the Kuryłowicz Condition. Whether violation could occur with sequences of say, stop and liquid is open.

The Kuryłowicz Condition itself does not suffice for a theory of syllable division, of course. It determines a syllable boundary only when the sequence of marginal segments between two syllables can be analyzed into permissible final and initial clusters in just one way. English *dogma* is an example. Call these *uniquely analytic* sequences.[1] There also occur *multiply analytic* sequences, as in English *extra*, with three possible divisions that satisfy the Kuryłowicz Condition. And, more rarely, one finds *unanalytic* sequences, for which no division yields permissible final and initial clusters. Spanish *transcripcion* is a stock example, since *-ns* does not occur at the end of Spanish words, nor does *scr-* occur initially.

3.1. *Principles of distributional syllabification.* We note in passing that it is possible to arrive at a formal definition by dividing the multiply analytic and unanalytic sequences uniformly and arbitrarily, for example assigning the entire sequence to the first syllable. This definition was actually adopted by Bjerrum (1944), according to Koefoed (1967:177). It is also the Icelandic orthographic convention (Einarsson 1949). In contrast, the distributional theories of syllabification of Kuryłowicz, Haugen, O'Connor and Trim, and Pulgram all seek principled, non-arbitrary procedures to divide these sequences. They differ mainly in how they go about it. In the following discussion I will concentrate on the basic principles that their procedures embody, rather than discuss each in detail. Table II will aid the reader to keep track of the connection between principles and theories.

The first principle in the table, 'Kuryłowicz Condition dominant', indicates whether a uniquely analytic sequence *must* be divided into permissible final and initial clusters, or whether there are exceptions governed by some other principle. Kuryłowicz relaxes the application of the condition only in favor of the 'Open Syllable' principle, which states that

(4) A single intervocalic consonant belongs to the following syllable.

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[1] The terms in '-analytic' refer to properties of marginal sequences. I think it is worth distinguishing them from those in 'divisible' on one hand and 'resolvible' on the other. My practice is to reserve 'divisible' for perceptual judgements (Bell 1970:40). Resolvibility, like analyticity, is a purely formal property and refers to the inclusion of shorter occurring or permissible sequences within longer ones. The notion is exploited by Greenberg (1965), who attributes the original concept to Hjelmslev. The difference is that for resolvibility, the sequences in question occur in the same position (initial cluster including initial cluster, medial cluster including medial one, final including final); whereas analyticity is restricted to medial sequences and pertains to their inclusion of terminal clusters.

We see below in the discussion of the 'Minimal Coda' principle that (4) is too strong.

TABLE II: PRINCIPLES OF SYLLABLE DIVISION

	Kuryłowicz Condition dominant	Uniform divisibility	Open syllable	Minimal coda	Irregular coda
Kuryłowicz	−	−	+	−	+
Haugen	−	+	−	−	−
O'Connor-Trim	+	+	−	−	−
Pulgram	+	−	+	+	+

3.2. *The procedures of Haugen and O'Connor-Trim.* The principle of 'Uniform Divisibility',

(5) Medial sequences of the same length are divided in the same way for a given language,

is the cornerstone of the theories of Haugen and O'Connor-Trim. It undeniably captures a general tendency: one expects a single consonant to syllabify with the following vowel, two consonants to be separated by syllable division, and so on, with certain exceptions owing to the Kuryłowicz Condition or to the presence of grammatical boundaries. It falls short of being a universal principle, however.

If applied to all medial sequences, as Haugen, at least if taken literally, proposes, the 'Uniform Divisibility' principle leads to such unacceptable conclusions as the identical division of the uniquely analytic three-segment sequences in *anxious* [-ŋkš-] and *obstacle* [-bst-]. Even if uniquely analytic sequences are excepted, the principle does not appear to coincide with the descriptions of some languages. Luganda has medial sequences of nasal + obstruent as well as geminate consonants. Both are unanalytic, for final syllables are open, and in initial sequences of nasal + stop or stop + stop the first element is syllabic. The two sequence types syllabify differently. Nasal + obstruent sequences form a tautosyllabic cluster with the following syllable, whereas geminates are divided (Tucker 1962, Cole 1967). And in general, it is not difficult to find cases where certain sequences are tautosyllabic, typically sequences of obstruent + liquid or fricative + stop, while others are heterosyllabic. Sometimes the deviant clusters are uniquely analytic, as in Yakur, a West African language (Bendor-Samuel 1969), and sometimes they are not, as in Cham, an Austronesian language spoken in Cambodia and Vietnam (Blood 1967).

Further, when we measure the 'Uniform Divisibility' principle against its utility in explaining wider phonological phenomena in terms of the syllable, again it appears to be lacking. A general statement of the Romance stress rule in terms of the syllable requires that some obstruent + liquid sequences be tautosyllabic. James Hoard (1971) and David Stampe (1972) posit different syllabifications for English words like *eerie* and *zero*, *meany* and *Reno*, *Mitty* and *Hittite*, providing an explanation for the difference in pronunciation of the medial consonants. Thus syllable-initial *t* in *Hittite* is tense and aspirated, syllable-final *t* in *Mitty* is lax and flapped.

Theo Vennemann (1972) pointed out that vowel lengthening in Icelandic can be stated very generally as occurring in open syllables if some, but not all medial obstruent + sonorant sequences that occur initially are taken to be tautosyllabic. Faeroese vowel lengthening is analogous, although the subset of permissible initial sequences that are tautosyllabic differs.

The principle of 'Uniform Divisibility' implies that neither the nature of the segments themselves, nor the accentual context in which they occur, plays a role in syllabification of medial sequences. The available evidence does not support this hypothesis.

3.3. *The procedures of Kuryłowicz and Pulgram.* The theories of Kuryłowicz and Pulgram do not differ greatly in their conceptual basis. I will treat only Pulgram's theory of syllable division, it being more recent, and more carefully worked out.

Pulgram resolves unanalytic sequences by the 'Irregular Coda' principle:

(6) If all divisions of a sequence yield a non-permissible initial or a non-permissible final cluster, the non-permissible cluster must be the coda.

Thus Spanish *trans.cripcion*.

Note that principle (6) will apply to all unanalytic sequences only under the doubtful assumption that they always contain a permissible initial cluster. The assumption would not hold, for example, in a language not permitting initial vowels unless all medial consonants occur also initially. (Here I assume, with Pulgram, that constraints on initial and final vowels are relevant to determining permissible terminals). For otherwise there would be a consonant k_i such that the sequence -Vk_iV- has no division yielding a permissible initial. Yerukala, a Dravidian tribal language, also appears to have medial sequences containing no permissible initial (Srinivasavarma 1969). Yerukala has neither initial nor final clusters; the segments /ṇ ṣ ḷ/ do not occur initially or finally; and /ɨ/ does not occur initially. Thus unanalytic sequences like /-oṇḍḷɨ-/ (from /poṇḍḷɨma:rɨ/

'wives') have no division which yields a permissible initial; and only the division /-o.ṇḍḷɨ-/ yields a permissible final.

Vennemann (1972) has pointed out that German [ˈraː.dlə] 'I bicycle' is an exception to the Irregular Coda principle, since **dl-* is not a permissible initial cluster. However, the North German variant [ˈraːt.lə] suggests that the principle may have diachronic application. Although the notion of permissible cluster in Kannada is hard to apply to available descriptions, because of conflicts between speech varieties, the medial sequences in /kak.sde/ 'I had it put' (Bright 1958), /cik.ṇi/ 'kind of betel nut', and /dak.ṣṇa/ 'south' (Hiremath 1961) also appear to be exceptions, since **sd-*, **ṇ-*, **ṣṇ-* do not occur initially.

Multiply analytic sequences, according to Pulgram, are divided according to the principle of the Minimum Coda, which subsumes the principle of the Open Syllable:

(7) If a medial sequence can be analyzed into permissible final and initial clusters in more than one way, the syllabification yielding the shortest coda is chosen.

Principle (7), like most of the others discussed above, has a certain validity. A common pattern is illustrated by Cham. Cham has initial clusters of obstruent + sonorant (*tr*, etc.) and obstruents occur finally. Medial obstruent + sonorant sequences are syllable-initial, not heterosyllabic (Blood 1967).

Heterosyllabic medial sequences are predicted by the Minimal Coda principle in the converse situation in which final, but not initial clusters occur, as in the indigenous words of Karačay, a Turkic language. Medial sequences of two segments that also occur as final clusters could, without violating the Kuryłowicz Condition, syllabify with the preceding syllable, but they do not. All Karačay medial sequences are heterosyllabic (Hebert 1962).

Although many languages thus conform to it, and no one would presume to propose a contrary Minimum Onset principle, the Minimum Coda principle is still too strong.

To begin with American English, it is incompatible with the pronunciation of such words as *Singapore* [ˈsiŋ.əpor], *hangar* [ˈhæŋ.r̩], *historic* [hɪsˈtɔrɪk], *vestigial* [vɛsˈtɪdžɪəl], *Estonia* [ɛsˈtoniə]. (These and the following transcriptions are given by Kenyon and Knott 1953). Pulgram's (but not Kuryłowicz') actual procedure would in fact give this same syllabification. This is because in such cases, the preceding nucleus is a non-final lax vowel. Hence a division placing the entire marginal sequence with the following syllable is not permitted. But this is no more successful, for we find also *cashier* [kæˈšir], *effete* [ɛˈfit], *effluvium* [ɛˈfluvɪəm], *necropolis* [nɛˈkrapəlɪs], *plurality* [plʊˈrælətɪ], and so forth.

More importantly, the Minimum Coda principle (7) shares the incompatibility of the principle of Uniform Divisibility (5) with respect to the general formulations concerning English stress placement, English tenseness and aspiration, and Icelandic and Faroese vowel length mentioned above. The reason is that the principle of the Minimal Coda, like that of Uniform Divisibility, entails that certain classes of medial consonant sequences will syllabify in the same way — no matter what the nature of their individual segments, no matter what their accentual context of occurrence. And the classes distinguished by the Minimal Coda principle — medial sequences not having the same possibilities of analysis into final and initial clusters — do not provide universal explanatory advantage.

4. Conclusion

The specific theories of the distributional syllable that have been proposed are unsuccessful. They are unsuccessful because their implicit or explicit conceptual bases, (1) through (7), are stretched too far. These principles thus should not be adopted as a basis for language description, as has happened.[2] This practice is not harmless. It robs the linguistic community of whatever empirical observations about syllabic phenomena that might have been made independently of these assumptions.

The present inadequacy of the distributional syllable notwithstanding, it is of course still possible that the basic assumptions hold, their vindication awaiting only the discovery of the correct formal definition of the syllable. This is a judgement the reader will want to make for himself. My own view is that the basic assumptions of the distributional syllable, stated in the introduction, are untenable.

The problem of the syllable in phonological theory is the problem of the organization of segment strings, including their accentual and tonal properties. Segment strings exhibit strikingly regular patterns of organization, yet their possibilities of organization appear to be far too complex to be accounted for by constructs based on a few selected near-universal regularities of distribution.

It follows that the syllable is not likely to be a unit derivable from abstract phonological properties, just as at the phonetic level it has not been possible to derive it from phonetic features. The other basic assump-

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[2] For example, McArthur and McArthur (1956) for Aguacatec, Sommer (1968, 1970) for the Kunjen dialects of Australia. I suggest that Sommer's theoretical orientation led him to claim that all medial margin sequences formed the coda of the preceding syllable, so that there were no syllables with onsets. Any discussion of other evidence for syllable division was omitted. Such evidence does exist, not supporting his unlikely conclusion (Dixon 1970).

tion of the distributional syllable, that it is defined without reference to phonetic realization, is likewise untenable, as is shown by its general weakness in accounting for phenomena beyond segmental phonotactics.

One conclusion I do not draw yet is that phonology can do without the syllable. For the concept of the syllable to contribute to phonology, it should be promising to assume, just as we assume that speech is organized into segments, that segments are organized into syllables, both phonetically and at more abstract levels. Let us, however, guard against too narrow a view, against confusing a tool with the problem. 'Defining the syllable' and 'proving the existence of the syllable' are pseudo-problems. Segment organization is the problem. If assumption of a syllabic unit leads to explanation of regularities of segment organization, so much the better. If not, we will be awaiting a more general theory of organization, and the syllable may enter the museum's Hall of Scientific Constructs, taking its place beside ether, the noble savage, and the like.

Arnold, G.F. 1955-56. "A phonological approach to vowel, consonant and syllable in Modern French". *Lingua* 5.253-281.

Arnold, G.F. 1964. "Vowel and consonant: a phonological definition reexamined". *In Honour of Daniel Jones*, ed. D. Abercrombie et al. London.

Beach, D.M. 1938. *The Phonetics of the Hottentot Language*. Cambridge.

Bell, A. 1970. *A State-process Approach to Syllabicity and Syllable Structure*. Ph. D. diss.: Stanford University.

Bell, A. 1975. "If speakers can't count syllables, what can they do?". mimeo, *Indiana University Linguistics Club*.

Bendor-Samuel, J.T. 1969. "Yakur syllable patterns". *Word* 25.16-23.

Bjerrum, A. 1944. *Fjoldmålets lydsystem*. Copenhagen. (cited by Koefoed).

Blood, D.L. 1967. "Phonological units in Cham". *Acta Linguistica* 9:8.15-32.

Chomsky, N. 1959. Review of *Essays in Linguistics*, by J.H. Greenberg. *Word* 15.202-218.

Cole, D.T. 1967. *Some features of Ganda Linguistic Structure*. Johannesburg (= *African Studies* 24.3-54, 71-116, 119-240).

Dixon, R.M.W. 1970. "Olgolo syllable structure and what they are doing about it". *Linguistic Inquiry* 1.273-276.

Einarsson, S. 1945. *Icelandic*. Baltimore.

Greenberg, J.H. 1962. "Is the vowel-consonant dichotomy universal?". *Word* 18.73-81.

Greenberg, J.H. 1965. "Some generalizations concerning initial and final consonant sequences". *Linguistics* 18.5-34.

Gregores, E. and J.A. Suárez. 1967. *A Description of Colloquial Guaraní*. The Hague.

Haugen, E. 1956a. "The syllable in linguistic description". *For Roman Jakobson*, ed. M. Halle et al.,213-221. The Hague.

Haugen, E. 1956b. "Syllabification in Kutenai". *International Journal of American Linguistics* 22.196-201.

Hebert, R.J. 1967. "Karačay phonology". *American Studies in Altaic Linguistics*, ed.

N. Poppe, 97-113. Uralic and Altaic Series 13. Bloomington.

Hoard, J.E. 1971. "Aspiration, tenseness, and syllabication in English". *Language* 47.133-140.

Hooper, J.B. 1973. *Aspects of Natural Generative Phonology*. Ph. D. diss.: University of California, Los Angeles.

Kenyon, J.S. and T.A. Knott. 1933. *A Pronouncing Dictionary of American English*. Springfield, Mass.

Kloster Jensen, M. 1963. "Die Silbe in der Phonetik und Phonemik". *Phonetica* 9.17-38.

Koefoed, H.A. 1967. *Fonemik. Orientering i fonemteori og fonemisk analyse.* Oslo.

Kuryłowicz, J. 1948. "Contribution à la théorie de la syllabe". *Polskie Towarzystwo Językoznawcze Biuletyn* 8.80-114.

Lebrun, Y. 1966. "Sur la syllabe, sommet de sonorité". *Phonetica* 14.1-15.

McArthur, H. and L. McArthur. 1956. "Aguatec (Mayan) phonemes with the stress group". *International Journal of American Linguistics* 22.72-76.

McIntosh, J.B. 1945. "Huichol phonemes". *International Journal of American Linguistics* 11.31-35.

O'Connor, J.D. and J.L.M. Trim. 1953. "Vowel, consonant, syllable — a phonological definition". *Word* 9.103-122.

Pike, K.L. 1943. *Phonetics*. Ann Arbor.

Pulgram, E. 1969. *Syllable, Word, Nexus, Cursus*. The Hague.

Rand, E. 1968. "The structural phonology of Alabaman, a Muskogean language". *International Journal of American Linguistics* 34.94-103.

Sommer, B.A. 1969. *Kunjen Phonology: Synchronic and Diachronic*. Pacific Linguistics. Series B – Monographs 2. Canberra.

Sommer, B.A. 1970. "An Australian language without CV syllables". *International Journal of American Linguistics* 36.57-58.

Srinivasavarma, G. 1969. "Phonology of Yerukala". *Dravidian Linguistics. Proceedings of the Seminar on Comparative Dravidian*, ed. S. Agesthialingom and N.K. Raja, 187-202.

Stampe, D. 1972. *How I spent my Summer Vacation*. Ph. D. diss: University of Chicago.

Tucker, A.N. 1962. "The syllable in Luganda: a prosodic approach". *Journal of African Languages* 1.122-166.

Vennemann, T. 1972. "On the theory of syllabic phonology". *Linguistische Berichte* 18.1-18.

Tone and Intonation in Guyanese English

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The present paper offers a few notes on the intonation of Guyanese English as spoken by my friend and former colleague, Dr. S.R.R. Allsopp of the University of the West Indies.[1] Dr. Allsopp, as well as speaking Caribbean Educated English and Southern British Standard English, has native knowledge of Guyanese English (GyE) both at the Creole level and at levels above.

Although there are excellent descriptions of the dialect continuum in Guyana (Allsopp 1958, 1962; Bickerton 1973) and elsewhere in the Caribbean, especially in Jamaica (e.g. Bailey 1966, DeCamp 1960, Cassidy 1967, Wells 1973), these descriptions, in general, have tended to neglect prosodic features.

And further, it would appear from what has been written, that there is some doubt as to the exact nature of the accentual system (or systems) of Caribbean English (CE). Nearly all writers agree that CE differs conspicuously from most British and American dialects in a number of prosodic features, most notably, perhaps, in its characteristic rhythms and intonations. Accent is generally described in terms of stress (e.g. Bailey 14-17, Cassidy xliv, DeCamp 137-139 and Wells 21-24 on Jamaican English; Bickerton 28-36, Holder (by implication) 897-898 on Guyanese English). At the same time, however, it is often noted that the stress system is "simpler than that of RP or American English" (DeCamp) and that "it is not always easy to distinguish stressed and unstressed syllables" (Cassidy, DeCamp) especially "since there is little or no phonetic modification in unstressed syllables such as occurs in RP or American English" (Cassidy, DeCamp; Bickerton).

An early dissenter from the general view, Lawton (1963) describes Jamaican English at the Creole level as if, essentially, it were a tone language. More recently, Allsopp (1972) and Spears (1972) have claimed a pitch-accent for Caribbean, including Guyanese, English and Cayman English respectively. The latter view is the one taken in this paper.

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[1] The data for this paper was assembled during periods of collaborative research at Northwestern University in 1975. Dr. Allsopp's visits to Northwestern were made possible by a grant from the Social Science Research Council.

Consider the following representative sample of GyE said with 'normal' (i.e. unemphatic) and fairly neutral intonation:

(1) ˈGive the ˈold-man a ˈpacket.[2] [‾ — — ‾ _ — _]

Stress is as marked: strong stress (marked ˈ) falls on the first syllables of the three content words *give, old-man* and *packet*. Other syllables have weak stress (unmarked). Syllables are said on different, fairly level pitches, and the pitch changes from one discrete level to another in 'steps' and not in contours spread over syllables. This type of intonation is very reminiscent of pitch phenomena found in the so-called 'tone languages' of West Africa.

Accent

Example (1) contains two dissyllabic nominals: the compound (or quasi-compound) noun *old-man* and the noun *packet*. In (1), the former is pronounced with lower (level) pitch on the first syllable which we leave unmarked and higher (level) pitch on the second which we mark with an acute accent; in final position (before #) and in citation form, *old-man* might be pronounced with terminal fall: thus

(1b) old-mán#. [_ \]

In (1) *packet* is pronounced with high (level) pitch on the first syllable and low (level) tone on the second and it might be so pronounced in citation form. In 'included' position, at least two pronunciations are possible.

(1c) - pácket - [‾ ‾] or [‾ _]

Of the two contrasting sequences, the low-high sequence is probably the more common in GyE. It occurs, for example, on almost all personal and place names, thus providing the well-known minimal pairs, first noted, I believe, by Collymore (1956) in Barbadian English, in which one item is a personal name and the other the name of a trade or profession: e.g.

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[2] Since this paper is concerned exclusively with suprasegmental features, for easy identification, texts are given in standard orthography wherever possible. Both Allsopp (1958 and 1962) and Bickerton describe the segmentals of GyE and provide useable broad transcriptions.

Taylór, Masón, Farmér vs. *táilor, máson, fármer.*[3]

On three-syllable words the common sequences in GyE are (marking only the first high syllable): e.g. *cónstable, newspáper, pepperpót*. Pitch in these examples is realized by the following rules: the marked syllable has high pitch; syllables preceding the marked syllable always have low pitch. Syllables following the marked syllable have pitches determined by position in the sentence and by the sentence intonation: they may therefore have equal or lower pitch. In citation form, the three examples might be pronounced:

(1d) cónstable [¯ ¯ _] newspáper [_ ¯ _] pepperpót [_ _ \]

Monosyllabic words in GyE mostly have high inherent pitch. A few form-words, the determiners, for example, have low inherent pitch. Other form-words have 'strong' and 'weak' forms with high and low pitch respectively: the personal pronouns, for example, *she* (she, her); *shé* (emphatic) and the partitive *some* (a little, a few); *sóme* (a part, not all). It should be noted that the inherent pitch of a word in GyE is often changed by special sentence intonations and the pitch contrasts between lexical items are thereby neutralized. An extreme example of pitch levelling is given in (2) below.

(2) Gíve the old mán a pácket. [¯ _ _ _ _ _ _ _]

This type of intonation is fairly common in commands and requests when it signals impatience on the speaker's part; in parenthetical statements:

(3) Twó, I téll you. [\ _ _ _]

and in sentences in which a contrastive emphasis is given to a word or words. Examples of contrast-emphasis with pitch-levelling are given in (14) and (17) below.

Sentence Intonation

The different intonations of 'normal' utterances so far encountered in GyE can be reduced to two main types. In the first type, roughly speaking, the pitch starts at a relatively high level and descends to a lower level at or near the end of the sentence. This type of 'falling' intonation is used with assertions, commands and requests and X-questions. (1) above is an example.

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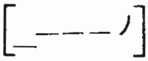
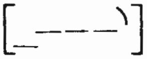
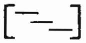
[3] Allsopp (1972:15) gives a rather complete list of such minimal pairs.

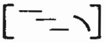
In the second type of sentence intonation, again roughly speaking, the general direction of the pitch movement is reversed; starting at a relatively low level the pitch ascends in a series of 'upsteps' to a relatively high level at or near the end of the sentence. Rising intonation is used in two types of utterances: in YES/NO questions and question tags and in certain exclamatory sentences which express surprise on the speaker's part. In questions, the final syllable ends in an upward glide (4a), in exclamations it may end in 'fall' or, less commonly, perhaps, in level pitch (4b).

(4a) So she's here again? 

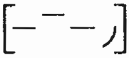
(4b) So she's here again! 

There are at least three variants of the falling intonation: these differ only in the pitch of their final syllables. The first variant ends in a fall. (The fall is by glide if the sentence ends in a single high):

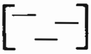
(5a) Gíve mé sóme. 

(5b) Gíve mé some bréad. 

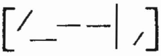
The second variant ends in a low pitch with terminal rise (whatever the inherent pitch of the final syllable):

(6) I want one pot. 

It is less 'abrupt' than the first variant. The third variant ends in a level pitch:

(7) Trý and éat. 

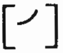
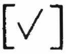
Both the third and second variants occur in the compound intonation in (8) below:

(8) What you reading, John? 

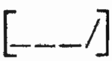
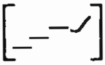
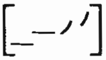
The main body of the intonation in all three falling variants can be stated as a structurally predictable sequence of high and low pitches with 'downdrift' rules. Briefly these rules provide that a high tone preceded by one or more low tones will be on a relatively lower pitch than any preceding high in the same sequence: in (1) above, the high tone on *pá(cket)* is lower than the high tone on *mán* which in turn is lower than that on *gíve*.

An unbroken series of two or more high tones will be level unless 'downstep' intervenes. In (5) above downstep occurs optionally between *gíve* and *mé*.[4]

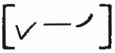
There are two main intonations associated with YES/NO-questions and question-tags. The elliptical questions in (9) below are examples of these intonations occurring on a single syllable. Both end in higher rise than the rise in (6) and (8) above.

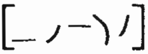
(9a) Two?  (9b) Two?! 

In longer sequences, the pitch starts at a relatively low level and rises to a high. The rise is achieved by 'upsteps' from one discrete level to another at word boundaries, or by glides:

(10) All-yóu wánt lícks?  or  or 

In the second variant intonation, which generally signals surprise or incredulity on the speaker's part, terminal rise is reinforced by a preceding fall. The fall may occur on the same syllable as the rise, as in (9b) above, or earlier in the intonation:

(11) Óne pót nów?! 

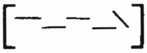
(12) You wánt to páss, na? 

Special Intonations

Basic intonations can be modified in several ways. Devices for emphasis, for example, include the following:

I. overriding of 'downdrift' (and 'downstep') rules
II. expansion of the pitch range
III. substitution of 'emphatic' tones
IV. pitch-levelling
V. tone-shift

Downdrift rules may be overridden throughout an entire intonation: this is a common feature of exclamations: in the following example,

(13) Whát a lót of ráin! 

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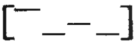
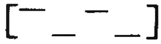
[4] Spears 1972 gives a succinct and lucid account of downdrift in Cayman English.

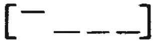
the high pitches, despite intervening lows, are all at approximately the same level.

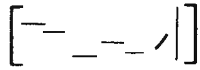
Sometimes, only a word or syllable of a word is affected: in (13b) below,

(13a) Pút some súgar.  < (13b) 

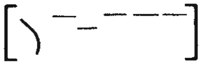
in which the word *súgar* is emphasized for contrast, its first syllable has about equal pitch to that of *pút*.

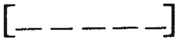
Any word (or stressed syllable of a word) to be emphasized may be given higher or lower than normal pitch: say /5/ and /1/ against normal /4/ and /2/.[5] Other syllables may or may not be levelled at /2/.

(14a) JÓHN (not x) is cóming. 

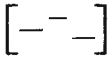
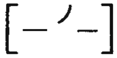
(14b) If you COMEOUT the bus,
(I'll beat you). 

Entire utterances may be spoken on pitches /5/ or /1/, usually with levelled intonation. Such utterances usually express contempt or disgust on the speaker's part.

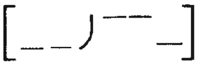
(14c) Eh, look at this woman! 

(14d) That is a motor-car. 

In almost any sentence, a glide from about mid-level to high can be substituted for the first high level pitch, with some increase in emphasis:

(15a) a húndred.  <> (15b) 

An expansion of this glide (from low to high level) gives added intensity. The syllable on which the rise takes place may be extended or 'drawled', sometimes to an extreme degree:

(16) is a lá::zy lí'l bóy. 

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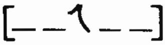
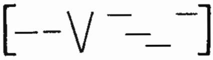
[5] The characteristic range, within which the pitch fluctuates, is generally much wider in GyE than in most British and American dialects and more frequent use is made of the higher and lower pitches within the range. It would seem that the higher levels of pitch are sometimes produced as in (14c) with falsetto phonation, the lower levels of pitch with 'breathy' voice, as in (14d).

Words of special semantic importance, with whatever intonation, are frequently 'drawled' in GyE. This feature is common to all varieties of CE and is noted in most descriptions.

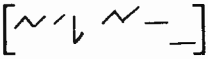
Both rise and subsequent fall may be compressed within a single word or syllable of a word in contrast-emphasis: the result in (17) is 'scoop' preceded and followed by low level pitches:

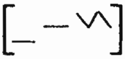
(17) ROBINSÓN gó hóme. 

Examples of 'dip' tone have been given in (9b)-(12). This tone is not restricted to question intonations but occurs frequently as an alternative to 'scoop' in 'emphatic' statements.

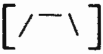
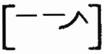
(17b) I was so disappointed. 

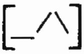
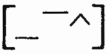
'Dip' and 'scoop' tones may be further reinforced to give rise-fall-rise and fall-rise-fall on a single (usually 'drawled') syllable:

(17c) Do, teacher, don't beat me. 

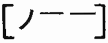
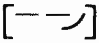
(17c) She's too kind. 
(disapproval)

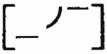
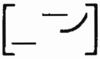
Somewhat related (and a characteristic feature of GyE) is tone-shift. In the following pairs of calling vocatives, the special intonation, a high rise-fall, is spread over the entire word or, as in (17) above, falls on the final syllable:

(18a) Péterkin!  or (18b) 

(19a) Robérta!  or (19b) 

But in (20b) and in (21b) the rise is best considered to be 'shifted' to the final syllable.

(20a) Péterkin!  or (20b) 

(21a) Robérta!  or (21b) 

Summary

The salient prosodic features of GyE are, first, a pitch accent and second, a sentence intonation conspicuously different from the intonation of standard American or British English. Though high pitch in GyE and heavy stress in Standard English often coincide, this is not always so. In many words with falling stress in Standard English, the heavy stress equates with low pitch in GyE. Stress has a limited (word-marking) function in GyE, the occurrence of strong stress being restricted to word-initial syllables. The basic sentence intonation in GyE is reminiscent of the terrace-tone languages of West Africa in which the pitch changes by discrete steps from syllable to syllable in an overall pattern of downdrift. A reasonable assumption is that the pitch accent is a residual element of the West African languages which form the substrate of Caribbean English. GyE is not today a 'tone' language (if indeed it ever was) but in both its accentual and intonational systems it provides an interesting example of linguistic syncretism.

Allsopp, S.R.R. 1958. *Pronominal Forms in the Dialects of English used in Georgetown (British Guiana).* University of London Master's thesis.

Allsopp, S.R.R. 1962. *Expressions of State and Action in the Dialect of English used in the Georeggetown area of British Guiana.* University of London Doctoral thesis.

Allsopp, S.R.R. 1972. "Some suprasegmentals of Caribbean English". Paper presented to UWI/UNESCO Conference on Creole Languages and Educational Development. Trinidad.

Bailey, B.L. 1966. *Jamaican Creole Syntax.* Cambridge.

Bickerton, D. n.d. *Guyanese Speech.* Georgetown: mimeographed.

Cassidy, F.G. and R. LePage. 1967. *Dictionary of Jamaican English.* Cambridge.

Collymore, F.A. 1955. *Notes for a Glossary of Words and Phrases of Barbadian Dialect.* Bridgetown.

DeCamp, D. 1960. *Four Jamaican Creole texts.* Creole Language Studies 1. London.

Gimson, A.C. 1962. *An Introduction to the Pronunciation of English.* London.

Holder, M.A. 1971. "Word accentual patterns in Guyanese English". *Abstracts of the VIIth International Congress of Phonetic Sciences.* Montreal.

Lawton, D.L. 1963. *Suprasegmental Phenomena in Jamaican Creole.* East Lansing: Ph. D. diss.: Michigan State University.

Spears, R.A. 1972. "Pitch and Intonation in Cayman English". Paper presented to UWI/UNESCO Conference on Creole Languages and Educational Development. Trinidad.

Wells, J.C. 1973. *Jamaican Pronunciation in London.* Oxford.

Universal Properties of Umlaut and Vowel Coalescence Rules: Implications for Rotuman Phonology

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One goal of this paper is to describe some rather interesting morphological and phonological phenomena of Rotuman, the language spoken on the island of Rotuma, about 200 miles N.N.W. of Fiji.[1] These phenomena pose a theoretical problem because, according to those versions of phonological theory which seem most plausible, there is no convincing way of choosing between the two analyses of them presented in this paper. In order to claim that the grammar put forth by the linguist is a description of the native speaker's linguistic competence, it is necessary that there be a unique grammar. Although I am not able to provide a formal revision in linguistic metatheory for solving the problem presented here, I provide a rather sketchy approach to a solution, based on certain empirically testable notions of 'rule naturalness'. Evidence from a number of languages is presented which suggest some interesting universal constraints on relative vowel heights and rounding in umlaut and vowel coalescence rules. According to these constraints, one of the two otherwise equivalent analyses of Rotuman is evaluated as clearly more highly valued than the other.

The theoretical framework in which the two analyses of Rotuman are presented is, roughly, that presented in Chomsky and Halle's *Sound Patterns of English* (1968; hereinafter SPE). There have, of course, been advances in phonological theory since the publication of that book, but it seems that those formal aspects of the theory which pose the problem under discussion later in this paper have not been superseded in a way which would make this problem disappear.

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The Rotuman Phenomena

The phenomena of interest in Rotuman are described here with some simplification of the phonetic facts which, I believe, does not mar the analyses to be presented; for example, I ignore the distinction between tense and lax vowels, which would only complicate the presentation without suggesting a solution to the theoretical problem posed by the Rotuman phenomena.

The most remarkable feature of Rotuman is that, for each Noun, Verb, and Adjective root, there exists a so-called 'complete' and 'incomplete phase'. This is illustrated in the broad phonetic transcriptions of sentences (1) and (2).

(1) [famóri fe'én] 'the people are zealous'
(2) [famö́r fe'éni] 'the zealous people' or 'zealous people (in general)'

The symbol ['] indicates a glottal stop.

[fe'én] is the incomplete phase of the adjective meaning 'zealous'; [fe'éni] is its complete phase. The incomplete phase of the noun for 'people is [famö́r]; its complete phase is [famóri]. According to Churchward (1940), "the word *fe'en* illustrates the general rule that, except in certain circumstances, a verb — or an adjective used as a verb — is used in its incomplete phase. The word *famör* illustrates the general rule that, except in a few special cases, a word is used in its incomplete phase when it is followed by a word that qualifies it . . .". These observations, coupled with phonological arguments presented later in this paper, suggest that (3) and (4) may be an appropriate underlying representation of (1) and (2) respectively.

(3) $_{\mathrm{S}}(_{\mathrm{NP}}(_{\mathrm{N}}(\text{famori})_{\mathrm{N}})_{\mathrm{NP}}\ \ _{\mathrm{VP}}(_{\mathrm{ADJ}}(\text{fe'eni})_{\mathrm{ADJ}})_{\mathrm{VP}})_{\mathrm{S}}$

(4) $_{\mathrm{NP}}(_{\mathrm{N}}(\text{famori})_{\mathrm{N}}\ \ _{\mathrm{ADJ}}(\text{fe'eni})_{\mathrm{ADJ}})_{\mathrm{NP}}$

There is no affix or other morpheme which signifies either the complete or incomplete phase; instead, a form which is in the incomplete phase is subject to phonological rules which do not apply to its complete cognate. I propose that the phonetic representations in (1) and (2) are derived from (3) and (4) by a set of regular readjustment rules and a set of phonological rules, some of which are sensitive to a morpheme feature introduced by the readjustment rules. The readjustment rules assign a '+' or a '−' value of a feature which we will call [complete] to each lexical morpheme in appropriate syntactic environments. Two examples of such rules are given in (5) and (6); further research is necessary to determine the nature of these rules in further detail.

(5) $\text{ADJ} \rightarrow [-\text{complete}]/{}_{\text{VP}}(\text{X}\_\_\_\_)_{\text{VP}}$

where X does not contain $_{\text{VP}}$(.

(6) $\text{N} \rightarrow [-\text{complete}] / {}_{\text{NP}}(\text{X}\_\_\_\_\text{Y ADJ Z})_{\text{NP}}$
where X does not contain NP(and neither Y nor Z contain NP).

The first Rotuman analysis

Both Rotuman analyses presented in this paper assume the mechanism described above for assigning values of [complete]; they differ in that they propose different phonological rules which are sensitive to the value of [complete]. Phenomena which illustrate the chief effects of these rules are given in (7).

(7)

	Complete	*Incomplete*	*Gloss*	*Rules for forming incomplete*
a.	[fe'éni]	[fe'én]	zealous	vowel deletion
b.	[famóri]	[famö́r]	people	Umlaut, vowel deletion
c.	[tíko]	[tíok]	flesh	metathesis

In the left column of (7) we see the complete phase, to which no phonological rules of interest here (except stress) apply; the right column is the broad phonetic representation of the incomplete phase. These are derived from their underlying representations by a set of phonological rules which operate only on forms marked [−complete]. In this analysis, these include a rule which simply deletes a final vowel, as illustrated in (7a) and (7b), a rule which umlauts the penultimate vowel, as in (7b), and a metathesis rule, illustrated in (7c). Before turning to a more complete exposition of these rules, I present some aspects of Rotuman phonology which, while they do not present any problems of analysis of themselves, are important to an understanding of the problematical phenomena.

Ignoring the distinction between tense and lax vowels, which is in part distinctive and in part determined by phonological rules, the systematic phonetic and systematic phonological vowels are as illustrated in (8) and (9).

(8) SYSTEMATIC PHONETIC VOWELS

	i	ü	e	ö	æ	a	o	u
high	+	+	−	−	−	−	−	+
low	−	−	−	−	+	+	−	−
back	−	−	−	−	−	+	+	+
round	−	+	−	+	−	−	+	+

(9) SYSTEMATIC PHONOLOGICAL VOWELS

	i	e	a	o	u
high	+	−	−	−	+
low	−	−	+	−	−
back	−	−	+	+	+
round	−	−	−	+	+

The most parsimonious assumption about the stress rule is that it assigns stress to every penultimate vowel and applies before all of the other phonological rules discussed in this paper. It is given in (10).

(10) STRESS

$$[+\text{syllabic}] \rightarrow [+\text{stress}] \;/\; X \underline{\qquad} C_0 V \;\#$$

Data such as those illustrated in (11) suggest a rule of FRONTING, given in (12).

(11)

	Complete	*Incomplete*	*Underlying representation*	*Gloss*
a.	[hála]	[hál]	/hala/	undercooked
b.	[hǽle]	[hǽl]	/hale/	part of roof
c.	[hǽke]	[hǽk]	/hake/	four
d.	[áfa]	[áf]	/afa/	to make a mark
e.	[ǽfe]	[ǽf]	/afe/	liver
f.	[tǽe]	[tǽ]	/tae/	to divide

(12) FRONTING

$$\begin{bmatrix} +\text{syllabic} \\ +\text{ low} \end{bmatrix} \rightarrow [-\text{back}] \;/\; X \underline{\qquad} [-\text{syllabic}]_0 \begin{bmatrix} +\text{syllabic} \\ -\text{high} \\ -\text{back} \end{bmatrix} Y$$

This analysis is motivated principally by two considerations. First, [æ] appears in the complete forms only when followed in the next syllable by [e], which in each of these cases is derived from /e/. The second consideration is that, in the incomplete forms, [æ] only appears in exactly those forms which contain an [æ] in the cognate complete form. It therefore seems reasonable to assume that they represent a single underlying segment, /a/, and that there exists a FRONTING rule, (12), which applies before the rule which deletes word final vowels in all incomplete forms.

We now turn to a consideration of the metathesis rule, which applies only to forms marked with the morphological feature value [−complete]. The application of this rule is illustrated in (13).

(13)

	Complete	*Incomplete*	*Underlying representation*	*Gloss*
a.	[úlo]	[úol]	/ulo/	kind of sea-bird
b.	[púre]	[púer]	/pure/	to rule
c.	[fúpa]	[fúap]	/fupa/	to distribute
d.	[tíko]	[tíok]	/tiko/	flesh
e.	[aíre]	[aíer]	/aire/	true
f.	[híwa]	[híaw]	/hiwa/	to curve in
g.	[fóra]	[fóar]	/fora/	to tell
h.	[séma]	[séam]	/sema/	left-handed

Metathesis applies just in case there is a [−syllabic] segment between the word final and the penultimate vowel and the word final vowel is lower than the penultimate vowel. This can be captured by the transformational rule METATHESIS I given in (14). The use of variables and conditions amount to a specification of the relative vowel heights described above.

(14) METATHESIS I[2]

STRUCTURAL DESCRIPTION

$$\begin{array}{cccccc} \# & X & \begin{bmatrix}+\text{syllabic}\\ \alpha\text{ high}\\ -\text{low}\end{bmatrix} & [-\text{syllabic}] & \begin{bmatrix}-\text{high}\\ \beta\text{ low}\end{bmatrix} & \# \\ 1 & 2 & 3 & 4 & 5 & 6 \end{array}$$

STRUCTURAL CHANGE 1 2 3 5 4 6

Conditions: (i) 2 - 5 is [− complete]
(ii) if $\alpha = -$, then $\beta = +$.

The symbol '#' is used to limit the domain of application of these rules. It corresponds roughly with word boundaries. A more careful study of Rotuman morphology is necessary before a more adequate system of boundaries can be proposed.

The umlaut phenomena are illustrated in (15). According to the analysis under consideration here, these involve a rule which umlauts the penultimate vowel, followed by a rule which deletes the word final vowel. These rules apply only to [−complete] forms.

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[2] Conditions on variables are used rather freely in this paper. It is unquestionably the case that such indiscriminate use of this device greatly expands the power of phonological theory. They are used here primarily to specify conditions of relative vowel height. Despite the theoretical disadvantage of this use of variables, I will use them anyway in lieu of a more constrained way or referring to relative vowel height.

(15)

	Complete	*Incomplete*	*Underlying representation*	*Gloss*
a.	[fúti]	[fǘt]	/futi/	to pull
b.	[hóti]	[hö́t]	/hoti/	to embark
c.	[čáči]	[čǽč]	/caci/	to shave
d.	[móse]	[mö́s]	/mose/	to sleep

A penultimate vowel is subject to UMLAUT, given in (16), if the word is in the incomplete phase and the word final vowel is both nonback and as high as or higher than the penultimate vowel. Of course, since these height restrictions are just the inverse of those stated for METATHESIS I, we need not state them in UMLAUT if we specify that METATHESIS I precedes UMLAUT in the grammar or Rotuman.

(16) UMLAUT

$$[+\text{syllabic}] \rightarrow [-\text{back}] \;/\; \#\; X \begin{bmatrix} \underline{\qquad\quad} \\ -\text{complete} \end{bmatrix} [-\text{syllabic}]\; [-\text{back}]\; \#$$

This formulation of UMLAUT assumes a convention whereby morphological features, such as [complete], inhere in each phonological segment.

Note that the theory of notational conventions given in SPE require that UMLAUT and FRONTING be collapsed into a single schema, described in (17). Perhaps this schema could be improved by a more felicitous formulation of the rules; it is nevertheless not obvious that collasping these rules captures a clear case of a linguistically significant generalization. Accordingly, (17) is offered only because it is mandated by a currently standard theory, but rejected for further consideration in this paper because of its questionable status.

(17) UMLAUT, FRONTING

$$[+\text{syllabic}] \rightarrow [-\text{back}] \;/\; \left\{ \begin{array}{l} X \begin{bmatrix} \underline{\qquad\quad} \\ +\text{low} \\ +\text{stress} \end{bmatrix} [-\ \text{syllabic}]_0 \begin{bmatrix} +\text{syllabic} \\ -\text{high} \\ -\text{back} \end{bmatrix} Y \\ \#\; X \begin{bmatrix} \underline{\qquad\quad} \\ -\text{complete} \end{bmatrix} [-\text{syllabic}]\; [-\text{back}]\; \# \end{array} \right\}$$

Finally, if the conditions for METATHESIS are not met, then VOWEL DELETION I (Abbreviated VDI) applies; VDI also applies to forms to which UMLAUT or FRONTING have also applied. The data which illustrate the application of VD I are given in (18); VD I is given in (19).

(18)

	Complete	*Incomplete*	*Underlying representation*	*Gloss*
a.	[píri]	[pír]	/piri/	to curl up
b.	[hífu]	[híf]	/hifu/	seven
c.	[fúfu]	[fúf]	/fufu/	to light up
d.	[fépi]	[fép]	/fepi/	to be slow
e.	[’élu]	[’él]	/’elu/	to beckon
f.	[péne]	[pén]	/pene/	to smell, reek
g.	[méŋo]	[méŋ]	/meŋo/	to refrain from crying
h.	[nóku]	[nók]	/noku/	to bulge
i.	[hóto]	[hót]	/hoto/	to jump
j.	[háŋu[	[háŋ]	/haŋu/	to awaken
k.	[háko]	[hák]	/hako/	to climb
l.	[háŋa]	[háŋ]	/haŋa/	to feed

(19) VOWEL DELETION I (VD I)

$$[+\text{syllabic}] \rightarrow [-\text{segment}] \;/\; \#\, X \begin{bmatrix} \underline{\qquad} \\ -\text{complete} \end{bmatrix} \#\text{[3]}$$

The notational conventions described in SPE provide a means for collapsing UMLAUT and VD I into the schema in (20).

(20) UMLAUT, VOWEL DELETION (UVD)

$$[+\text{syllabic}] \rightarrow \left\{ \begin{array}{l} [-\text{back}] \;/\; X \underline{\qquad\quad} [-\text{syllabic}]\,[-\text{back}] \\ \\ [-\text{segment}] \;/\; X \underline{\qquad} \end{array} \right\} \;/\; \# \begin{bmatrix} \underline{\qquad} \\ -\text{complete} \end{bmatrix} \#$$

Here again it seems a bit curious to require that the rules be collapsed in this way, as the standard theory does. Although it should be possible to specify the value of [−complete] only once for all three of these rules (a goal not achieved in this paper), it is odd to specify only one vowel to the left of the arrow, since this ‘similarity’ between the rules seems fortuitous and not principled. A number of proposals come to mind for restricting the notational conventions from collapsing these rules in this way, but I know of none that is supported by convincing evidence.

The chart in (21) is a schematic summary of the Rotuman phenomena.

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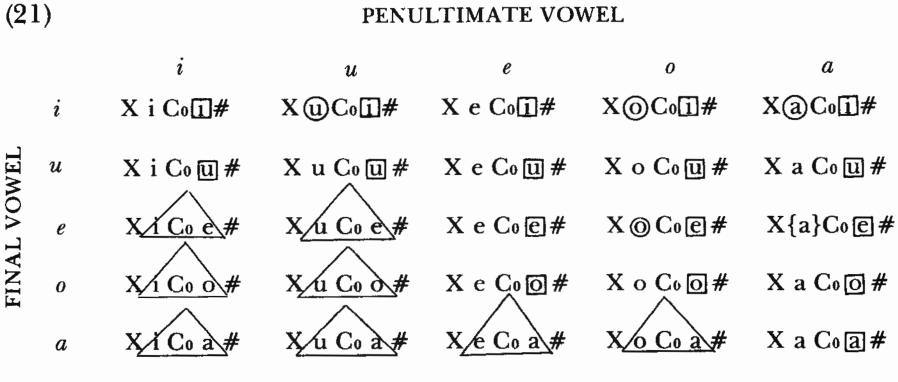
[3] The notation [−segment] indicates deletion of a segment.

(21)



PENULTIMATE VOWEL

FINAL VOWEL

	i	*u*	*e*	*o*	*a*
i	X i $C_0\boxed{i}$#	X ⓤ $C_0\boxed{i}$#	X e $C_0\boxed{i}$#	X ⓞ $C_0\boxed{i}$#	X ⓐ $C_0\boxed{i}$#
u	X i $C_0\boxed{u}$#	X u $C_0\boxed{u}$#	X e $C_0\boxed{u}$#	X o $C_0\boxed{u}$#	X a $C_0\boxed{u}$#
e	X i C_0 e #	X u C_0 e #	X e $C_0\boxed{e}$#	X ⓞ $C_0\boxed{e}$#	X{a}$C_0\boxed{e}$#
o	X i C_0 o #	X u C_0 o #	X e $C_0\boxed{o}$#	X o $C_0\boxed{o}$#	X a $C_0\boxed{o}$#
a	X i C_0 a #	X u C_0 a #	X e C_0 a #	X o C_0 a #	X a $C_0\boxed{a}$#

In this chart, 'X' consists of '#' followed by a string of phonological segments; hence, each string depicted in the chart indicates the systematic phonological representation of a word, roughly. Those words which are subject to METATHESIS I are marked with a triangle including the segments in the structural description of the rule. Vowels which become umlauted are indicated by a circle around the affected vowel. The application of VD is shown by means of a square containing the vowel to be deleted. The one occurrence of curly braces specifies the vowel affected by FRONTING.

An alternative solution

The solution I have just sketched is not the only solution possible within the framework of the theory of phonology put forth in SPE. The only other alternative I have been able to think of which does not involve missing many more clear generalizations involves formulating a rule of metathesis which applies to every [−complete] form; the occurrence of front rounded vowels would be accounted for by a rule of vowel coalescence, and vowel deletion would be subject to height constraints which are, in effect, the inverse of the constraints on the version of METATHESIS I given in (14).

The new version of METATHESIS II is given in (22).

(22) METATHESIS II

STRUCTURAL DESCRIPTION	#	X	[+syllabic]	[−syllabic]	[+syllabic]	#
	1	2	3	4	5	6

STRUCTURAL CHANGE 1 2 3 5 4 6

Condition: (i) 2 - 5 is [−complete]

The rule of VOWEL COALESCENCE (VC), given in (23), specifies the relative height of the umlauted and the umlauting vowel, taking advantage of the fact that Rotuman has no low, nonback vowels at this stage of derivation in the position indicated by '4' in the SD of (23).

(23) VOWEL COALESCENCE (VC)

STRUCTURAL DESCRIPTION

$$\begin{array}{cccccc} \# & X & \begin{bmatrix}+\text{syllabic}\\ \alpha\ \text{high}\end{bmatrix} & \begin{bmatrix}+\text{syllabic}\\ -\text{back}\\ \beta\ \text{high}\end{bmatrix} & \begin{bmatrix}-\text{syllabic}\end{bmatrix} & \\ 1 & 2 & 3 & 4 & 5 & 6 \end{array}$$

STRUCTURAL CHANGE

$$1\ \ 2\ \begin{bmatrix}3\\ -\text{back}\end{bmatrix} \begin{bmatrix}4\\ -\text{segment}\end{bmatrix}\ 5\ \ 6$$

Conditions: (i) 2 - 5 is [−complete]
(ii) if $\alpha = -$, then $\beta = +$.

VOWEL DELETION II (VD II), given in (24), specifies that the vowel in position '4' in the structural description must be as high as or higher than the vowel in position '3' for deletion to take place. Since this includes the set of values for height features relevant for VC, it is possible to collapse (23) and (24) into the schema given in (25).

(24) VOWEL DELETION II (VD II)

STRUCTURAL DESCRIPTION

$$\begin{array}{cccccc} \# & X & \begin{bmatrix}+\text{syllabic}\\ \alpha\ \text{high}\\ \beta\ \text{low}\end{bmatrix} & \begin{bmatrix}+\text{syllabic}\\ \gamma\ \text{high}\\ \delta\ \text{low}\end{bmatrix} & \begin{bmatrix}-\text{syllabic}\end{bmatrix} & \# \\ 1 & 2 & 3 & 4 & 5 & 6 \end{array}$$

STRUCTURAL CHANGE

$$1\ \ 2\ \ 3\ \begin{bmatrix}4\\ -\text{segment}\end{bmatrix}\ 4\ \ 6$$

Conditions: (i) 2 - 5 is [−complete]
(ii) if $\alpha = +$, then $\gamma = +$
(iii) if $\delta = +$, then $\beta = +$.

(25) VC — VD II

STRUCTURAL DESCRIPTION

$$\begin{array}{cccccc} \# & X & \begin{bmatrix}-\text{syllabic}\\ \alpha\ \text{high}\\ \beta\ \text{low}\end{bmatrix} & \begin{matrix}\begin{bmatrix}-\text{syllabic}\\ \gamma\ \text{high}\\ \delta\ \text{low}\end{bmatrix}\\ <-\text{back}>\end{matrix} & \begin{bmatrix}-\text{syllabic}\end{bmatrix} & \# \\ 1 & 2 & 3 & 4 & 5 & 6 \end{array}$$

STRUCTURAL CHANGE

$$1\ \ 2\begin{bmatrix}3\\ <-\text{back}>\end{bmatrix}\begin{bmatrix}4\\ -\text{segment}\end{bmatrix}\ 5\ \ 6$$

Conditions: same as in (24)

Relative evaluation of the two analyses

When we compare the most collapsed descriptions of the two analyses, we find that the evaluation criterion proposed in SPE, namely, feature counting, gives the first analysis a higher value. In particular, if we compare

METATHESIS I with METATHESIS II, we find that the former is more complex than the latter by specification of two more features in the SDs and of two more values in the set of conditions on application. The collapsed VC VD II is more complicated than UVD by five features in SDs and four values in conditionals. On balance, then, the second analysis is lower in value than the first by exactly two features in the SDs and by 2 value specifications in conditional statements.

There are a number of considerations which dictate caution in this evaluation. For one thing, there is some uncertainty about the validity of UVD, as discussed earlier. If UMLAUT and VOWEL DELETION I cannot be collapsed in this way, then the advantage of the first solution is virtually eliminated. But there exist even greater questions about a blind adherence to a simple feature counting, although no other plausible formal complexity measure has been suggested. The safest conclusion, then, is that the evaluation criteria so far available do not provide a clear choice between the two analyses of Rotuman.

The relative naturalness of the two analyses

The conclusion to the argument which follows is that the rule of vowel coalescence in the second Rotuman analysis is unnatural in an empirically verifiable sense and that the umlaut rule of the first analysis is natural, again in an empirically verifiable sense. (FRONTING is also shown to be natural by exactly the same criterion which accounts for the naturalness of UMLAUT.)

The form of the argument is as follows: first, I present some conclusions drawn from the study of vowel coalescence in a number of languages. It is shown that such rules obey certain constraints on the relative heights of the vowels involved, as well as on the rounding of the resulting vowel. We will assume that these constraints are due to some properties of language which we can only guess at with our present knowledge. But it seems plausible to suggest that a necessary condition for an adequate evaluation criterion is that it specify that vowel coalescence rules which obey these constraints are higher valued than those that do not.

The second step of the argument is to show that VOWEL COALESCENCE, in the second analysis of Rotuman, does not obey all these constraints, and therefore should be given a relatively low value. Finally, I attempt to argue that the rules in the first analysis do not seem to violate any such constraints; therefore, the first analysis is preferable to the second on grounds deriving ultimately from universal features of vowel coalescence and umlauting rules.

Vowel coalescence

A rule is said to be a rule of *vowel coalescence* just in case the structural description of the rule contains two adjacent vowels which appear in the structural change as one vowel, different in quality from either of the two vowels in the structural description. By 'different in quality' I mean that the resultant vowel has a configuration of height, backness and rounding feature values different from either of the original two vowels. The tenseness or length of the resulting vowel is immaterial to this definition.

In a survey of over 200 languages, I have been unable to find counter-examples to the claim that, in all rules which meet the above definition, the resultant is never a front rounded vowel nor a back, nonlow, unrounded vowel. That is, except for an occasional [ɔ], the resultant vowel is always unmarked for rounding.

A second generalization which holds true for the sample is that no vowel coalescence rule may be formulated so as to rule out coalescing a sequence containing a high and a low vowel (order is immaterial). That is, many languages have vowel coalescence rules which affect a sequence of a high and low vowel and no other sequences. In some of the languages where such sequences coalesce, sequences of a high and a mid, or of a low and mid, or both, also coalesce. However, it is never the case that a language contains a vowel coalescence rule as defined above such that only a sequence of a high and a mid, or a sequence of a mid and a low, is affected and not a sequence of a high and a low.

VOWEL COALESCENCE, (23), meets the definition of vowel coalescence rules given above. VC violates the constraint against the resultant vowel being front and rounded, but seems to meet the condition on relative heights. Therefore, if we assume that violation of these conditions constitute some kind of 'cost', then VC is given a low value by virtue of violating one of at least two known conditions on rules of this form.

Umlaut

Umlaut is defined here as any rule which is not distinct from that given in (26).

(26) ARCHETYPICAL UMLAUT

$$[-\text{syllabic}] \rightarrow [-\text{back}] \;/\; X \_\_\_ C_0 \begin{bmatrix} -\text{syllabic} \\ -\text{back} \end{bmatrix}$$

My sample contains only five languages or language families with such rules: East Turki, the Germanic languages, Livian, Rotuman, and Takelma. Thus, the proposed constraints are more tentative than those proposed concerning vowel coalescence. But since Rotuman UMLAUT and FRONTING both seem to be perfectly ordinary sorts of umlaut rules, the conclusion seems inescapable that they are highly valued according to criteria suggested here.

This small sample seems to suggest that there are no universal restrictions on the height or roundedness of the vowel to the left of the arrow in umlaut rules; thus, in some cases, such as FRONTING, only low vowels become umlauted, and in others only the high vowel /u/ is umlauted.

Some interesting restrictions on the height assumed by the transformed vowel are suggested by the data. For one thing, an umlauted vowel is never lower than its 'source'. For example, a high vowel always remains high under this rule, but a low vowel may become nonlow. Thus, consider the cases of German and East Turki umlaut, given in (27).

(27) German (simplified) and East Turki Umlaut

$$[+\text{syllabic}] \rightarrow \begin{bmatrix} -\text{back} \\ -\text{low} \end{bmatrix} / \underline{\qquad} \text{C}_0 \begin{bmatrix} +\text{syllabic} \\ -\text{back} \\ +\text{high} \end{bmatrix}$$

In these cases, an underlying /a/ becomes [e], indicating that low vowels are raised when fronted by umlaut; mid and high vowels retain their original height. In Takelma, /o/ is umlauted to [ü]. I have no examples where umlauting lowers the vowel.

A further constraint involves the relative heights of the vowel in the environment and the vowel affected by the rule. The admittedly small sample contains no counterexample to the proposal that no umlaut rule may require the umlauting vowel to be lower than the umlauted vowel. Thus, a mid front vowel may cause a high back vowel to umlaut only when it is a special case of a rule whereby a high front vowel also causes the high back vowel to umlaut.

The Rotuman rules of FRONTING and UMLAUT do not violate either of these constraints. They both seem to be very ordinary umlauting rules. Therefore, since the first and second analyses do not differ in any substantive way except for the contrast between UMLAUT and VC, it seems that we should expect an empirically adequate evaluation criterion to assign a higher value to the first than to the second analysis of Rotuman.

Summary

We have seen that the standard theory, as described in SPE, does not provide a principled means for choosing between the two analyses of Rotuman. No well motivated principle for making this choice is currently available. The evidence from a number of languages suggests, however, that there may be principles, currently rather mysterious, which choose the first over the second analysis; these are the same principles which account for the 'naturalness' of umlaut and vowel coalescence rules which conform to the constraints on these kinds of rules proposed above. Further research is needed for confirmation and elaboration of these and similar constraints on the form of rules; further insights are needed to establish a linguistic metatheory which can account for these constraints.

Cairns, C.E. [In press]. "Universal rules and vocalic devoicing in Southern Paiute". *Festschrift for Archibald Hill.*
Chomsky, N. and M. Halle. 1968. *The Sound Pattern of English.* New York.
Churchward, C.M. 1929. "Definiteness and indefiniteness in Rotuman". *Journal of the Polynesian Society* 38.281-84.
Churchward, C.M. 1940. *Rotuman Grammar and Dictionary.* Sydney, Australia.

The Function and Status of Boundaries in Phonology

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> . . . such shadowy but indispensable concepts as phonological word boundaries. (Greenberg 1970:10)

"In phonology boundary elements play an indispensable role . . . The exact status of such elements in grammar has never been made clear", wrote Kim (1970), and, notwithstanding a far-reaching reorientation of theoretical perspective, his words remain true today. In §1 we explore the logical basis of the phonological boundary hypothesis within a pan-theoretical framework, in the sense that the analysis we outline will hold for any theory of phonology that operates with rules, whether they be the ordinary process rules or their functional equivalents such as rules for the distribution of allophones. As such, it departs somewhat from the customary phonological disquisition, which takes interesting cases from particular languages and examines their import for the theory; after all, there is also a place, and in the case of boundaries, a definite need for logical clarification of the claims and implications entailed by the adoption of a given descriptive device.

§2 is devoted to a critical overview of significant approaches to the boundary problem in its three main historical phases. In §3 we argue that previous use of the boundary device (as outlined in §2) is but an element of rather speculative descriptive frameworks resting on largely non-empirical criteria, and that the deductions reached in §1 on the function and status of boundaries in phonology — as well as the traditional evaluation of grammatical devices by checking extensional adequacy and probing the limits of intuitive appeal (as performed in §2) — are themselves to be viewed in the light of a far more cautious assessment of the potential and limitations of phonology as a scientific discipline.

1. Boundaries in phonology

There are two basic, largely unresolved problems involving the use of boundaries in phonology; these are:

1. what ARE phonological boundaries and what reasons are there for

distinguishing between phonological boundaries and simple morphosyntactic (ms.) boundaries?

2. what are the relations and distinctions in function between phonological boundaries and ms. rule environments and rule diacritics in the lexicon?

Phonological boundaries were used along with other devices in classical generative phonology with results that were, by and large, intuitively satisfactory given the theoretical framework. Recently the tendency has been to expand lexical marking and the listing of morphological environments in phonological rules, while at the same time to reduce or even eliminate the use of phonological boundaries other than the so-called "true" (Hooper 1975) phonological boundaries. Authors have rarely chosen to present a logical analysis and reasoned advocacy for their positions: it has been considered sufficient to achieve the correct output given the particular stance of the phonological theory in question. While such an intuitive approach may be eminently practical for writing a grammar, it quite fails to answer or even obscures the critical theoretical questions (1. and 2. above) concerning the status and function of boundaries in phonology.

Delimitation and specification of morphological and syntactic units in phonology. For the satisfactory formulation of phonological rules, it is often necessary to note (where possible or appropriate) at what point in strings of phonological segments morphological and syntactic units begin and end, and to describe those units insofar as their morphosyntactic classifications are relevant to the phonology. In other words, the morphology and the syntax could be viewed as providing bracketing and labeling for their respective units, whatever the precise formalism chosen for each. Since morphological and syntactic units always occur adjacent to one another or to beginning/end of discourse, it is evident that, whether explicitly or implicitly in the formalism, at every morphosyntactic seam there will be both a labeled end and a labeled beginning.

It is perfectly feasible, and it was quite common practice, though perhaps no more than a notational device, to simplify the strings of contiguous labeled brackets, so that to each different sequence there corresponds a unique symbol; (note that the order of brackets is critical: e.g. proclitic][noun is quite different from noun][proclitic). This translation into single boundary symbols can become quite complicated with the multiple brackets of the syntax and is perhaps more suited to the morphology. Such translation into an abbreviated description or a single symbol is common practice when it involves elimination of the bracket having the more general and automatically assumed specification, e.g. the particular boundary (prefix, say) contiguous with the general morpheme boundary, that is the unmarked value, becomes simply 'prefix boundary'.[1] In other cases a special symbol or a complete description will be required. In any case, the unit symbols and descriptions used represent a unit organization of the linear sequences of labeled ms. boundaries on a purely ms. basis, and they are very definitely to be distinguished from phonological boundaries.[2] As we shall see below, it is a valued situation if the distinctions of the former are adequate to the latter.

Analysis of the status and function of boundaries in phonology. Let us take the phonological rules of a language provisionally formulated without any ms. information: they will comprise the following three classes:

1. XY → ZY, always (wherever XY appears in a string it is always changed and always changed to ZY)
2. VW → VW, always (VW is never changed — vacuous rule): delete from the phonology as automatic and redundant
3. a. AB sometimes → CB
   b. AB sometimes → DB; and/or
   c. AB sometimes → AB; etc. ('contradictory rules').

In a structuralist phonemics the above are allophone distribution rules and should be interpreted in such a way that: segments to the left of the arrow are phonemes in the environment B, segments to the right of the arrow are allophones in the environment B, and to avoid a proliferation of phonemes it is required that in 3 C be in complementary distribution with D and/or A.

Note that vacuous rules in 3) must not be deleted from the phonology at this stage of the analysis. Since vacuous rules are not considered worth writing, conventions of correlating the phonology with the morphosyntax have been developed so that reference is always to application and non-application of mutational rules, implying an assessment of markedness.

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[1] McCawley (1968) and Stanley (1973) were wrong to suggest that the stronger boundary always won: such is the case more frequently with brackets facing in the same direction, e.g. morpheme] word], than with brackets facing in opposite directions, but it cannot be maintained as a rule.

[2] It will be immediately clear from our definition of phonological boundaries below that if there is to be an organization into unit symbols, it must be of ms. boundaries and not of phonological boundaries. Take the case of the boundary sequence proclitic] [enclitic, which can be translated into a single ms. symbol, say PE or 8; in the terms of phonological boundaries the translation would mean the following: there is a phonological boundary X that induces P-rules, say, 9-11 when standing before phonological boundary Y; phonological boundary Y is that which induces P-rules 12-15 when preceded by the phonological boundary most commonly preceding it; if phonological boundary X is followed by phonological boundary Z (that inducing P-rules 6-8 when standing after the phonological boundary it most commonly stands after) instead of Y, then, say, P-rule 9 does not apply! The complexity that arises from the conditional character of such an analysis of phonological boundaries makes it clear that phonological boundaries always correspond to at least two ms. boundary types facing in opposite directions (including of course zero boundary), and that consequently reduction to a single unit symbol, if it is to take place at all, must occur before the representation of the ms. information in terms of phonological boundaries, whether reduc-

But logically, in the case of the contrast: mutational rule – vacuous rule, if the mutational rule applies at the morphosyntactic boundary sequences B_i, then the vacuous rule applies at the complement, $\overline{B_i}$, i.e. elsewhere or at all other boundaries.

Where, as in 3., any two rules with contradictory outputs (including one mutational rule and one vacuous rule) would apply to the same string of segments (at the same point in the derivation, if the grammar has rule ordering), there — providing of course that the segments themselves are correctly posited and the rules, especially the phonological environments, correctly stated — the grammar will have to correlate particular phonological processes with the ms. categories or boundaries to which they apply or which they signal. The required correlations may be established in either direction: the 'diacritic' model references the applicable phonological rule at the ms. boundary sequence, while the 'environment' model references the ms. boundary sequences at the phonological rule. The diacritic model is widely used for lexical exceptions and the basic principle is recognizable in natural generative via-rules and structuralist morphophonemic transcriptions. The environment model is used, for instance, in natural generative morphologized rules. We shall first consider the former model briefly.

The diacritic model is commonly reserved as a mechanism for the statement of exceptions and is not used for the main body of the grammar, that is the regularities, which are formulated on the environment model. It is not our intention here to discuss in detail where each model is more appropriate; we would merely note in passing that there seem to be cases where, in purely quantitative terms, diacritics have a wider domain of application than boundaries; that there seems to be a preference for boundaries when differences in affix classes regulate phonological rules affecting segments in a root, and for diacritics when differences in sets of roots regulate phonological rules affecting segments in an affix; and finally that in a morpheme lexicon diacritics cannot be used in certain complex cases where simultaneous reference to more than one morpheme is necessary, unless conditional diacritics are permitted.[3]

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tion simply happens as an automatic consequence of the rules converting the ms. boundary sequences into phonological boundaries (as we assume — see below) or is due to a separate, still purely ms. process.

[3] The diacritic has to be assigned by the morphology or in the string; otherwise the diacritic will have to be made conditional on a preceding (or, respectively, following) morphological element, or, alternatively, liable to subsequent readjustment. Such a situation arises where A, B and C are phonological entities and:

A in morpheme m before B in morpheme n → C
A in morpheme m before B in morpheme p remains
A in morpheme q before B in morpheme p → C

that is, where the rule must make simultaneous reference to both different morphemes.

In any case, although it is usual to use a mixture of diacritics (for the more particularized cases) and boundaries (for the more general cases), it will be instructive for the purposes of our theoretical exposition to discuss the extreme position according to which all the correlations between the phonological rules and the morphosyntactic boundary sequences are conveyed using the diacritic model alone. This would involve a section of the grammar assigning each [±P-rule] diacritic feature to its ms. environments, however general or particular, i.e. to all the ms. boundary sequences at which it applies. However, this simple formal expression of the correlation leaves the data quite unorganized above the level of the individual rule, and this is definitely a drawback when it comes to the formal insertion and storage of the diacritics in the string: there are evident regularities and consistencies in the co-occurrence of diacritics at various boundary sequences, and these are best captured in the following way. The lists of P-rule diacritics applying at the various ms. boundary sequences should be organized into minimally distinctive sets. (If some of the ms. environments of the P-rules are not stated with maximally possible generality, then some of the sets of P-rule diacritics will contain zero values as well as plus and minus values, and it will be recalled that a zero value cannot serve to differentiate two matrices). From this organization of the diacritics into minimally distinctive sets on the principle of non-contrastivity, emic classes of P-rule diacritics will result, and emic symbols may be conveniently inserted in the string to represent them. These emic classes are the phonological boundaries of the diacritic model: they are sets of phonological processes classified on the basis of the morphosyntax. We now turn to a consideration of the environment model, where we shall see a similar organization.

It is very obvious that there is far more ms. detail in the string that is the output of the morphology and the syntax than is necessary for the purposes of processing that string correctly through the phonology. Likewise, it is clear that when ms. environments are listed in the phonological rules, they will not be listed in their full ms. specificity. In both cases, there are significant generalizations to be captured. Considerable generality is of course achieved in rule environments by use of maximally general ms. specifications, even by those who simply list ms. environments and do not invoke phonological boundaries. Nevertheless some ms. distinctions that are quite irrelevant for the operation of the phonology will clearly continue to be made, in those cases where a common ms. feature is not available, and often to be repeated from one phonological rule to another, which suggests that purely ms. criteria of generalization are not always fully adequate and consequently not primary even in phonological rule environments. When we turn to consider the specification of ms. information in the string, we see immediately that any attempt to generalize on a purely ms. basis will be fruitless: firstly, it would be arbitrary; secondly, it would often fail to capture all relevant generalizations (just as above in the rule environments); and thirdly, it would as likely as not make invalid generalizations that would render processing of the string through the phonology impossible.

We have shown that generalizations have to be made and that they cannot be made on a purely ms. basis; this is hardly surprising, since we are dealing not with the morphosyntax alone, but with the ways in which the morphosyntax is correlated with the phonology. What, then, are the criteria that will result in valid generalizations for the string?[4] They are the following conditions:

1. all ms. distinctions relevant for the correct functioning of the phonology must be kept
2. all ms. distinctions not relevant for the correct functioning of the phonology must be eliminated.

Application of these two conditions will generate classes of ms. boundary sequences as follows: all ms. boundary sequences at which the same list of P-rules applies (and, respectively, does not apply) are assigned to the same class. A list of P-rules is the 'same' as another list of P-rules if it is identical or if any differences between them do not involve contradictory rules in the sense of 3. above. The resulting classes may or may not be uniquely definable in terms of classes (independently) required by the morphosyntax.

More formally, + and − values may be assigned to ms. boundary sequences for the application of each phonological rule, including vacuous rules. Then, for two contradictory rules R and R′, some boundaries will show the property [+R] and [−R′], others [−R] and [+R′], and others again may have zero for both values. It is, of course, from the elimination of this redundancy that the popular notions of 'rule-blocking' and 'rule-requiring' boundaries (Stanley 1973) ultimately stem. Since zero is not a third distinct relation in which a ms. boundary sequence may stand with a phonological rule, it can never serve to produce phonologically distinctive classes of ms. boundary sequences. Therefore, if a ms. boundary sequence *a* is characterized by + rules R_i and − rules R_j, and a different ms. boundary sequence *b* is characterized by + rules R_i and 0 R_j, then *a* and *b* are not associated with distinctive classes of phonological rules, and consequently the ms. difference between them is not relevant for the phonology: cp. the principle underlying complementary distribution.[5] Or again, if two ms. boundary sequences x and y are both liable to rules R_i only and differ in rules R_j only, and if a third ms. boundary sequence z agrees with the first two in being liable to rules R_i but has a 0 value for rules R_j (e.g. due to facts of morpheme structure and combination), then, whether z be assigned to x or to y or to both, it cannot be considered a distinctive class.

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[4] As a purely formal variant, full ms. specification may be left in the string and membership of the more general classes that are used in the rule environments indicated in a separate set of 'redundancy' rules.

[5] The generality with which (phonological and) ms. features are specified in P-rules is a recurrent problem, and one which we shall consider here only with reference to boundary specification. For instance, it may happen, due to a set of distributional accidents, that the

But if we apply conditions 1. and 2. as described above, we must fully understand that we are no longer capturing generalizations by creating classes of ms. boundary sequences according to ms. criteria of classification: we are now creating classes of ms. boundary sequences according to PHONOLOGICAL criteria of classification. The principle of classification has changed from an internal to an external one, and if the principle of classification is external, the definition and characterization of the resulting classes must also be external, since the latter inevitably reflect the former. It is indeed the case that some externally definable classes may be, coincidentally, coextensive with internally definable classes, but not only is the latter not the primary and relevant classification, it is not a classification at all, since, unlike the external classification, it is not based on a logically structured system of criteria but is merely haphazard.

We can now see that on the environment model phonological boundaries are the classes generated by conditions 1. and 2., that is they are phonologically distinctive classes of ms. boundary sequences, whereas on the diacritic model they are morphosyntactically classified sets of P-rules. We have noted that the only non-arbitrary way to capture all generalizations about ms. categories that are significant for the processing of strings through the phonology is by generating these classes, i.e. by writing phonological boundaries in the string. As for the ms. environments of phonological rules, evidently they will be expressible through a formal mechanism compatible with that chosen for the string, that is in terms of one or more phonological boundaries. Thus, for any particular rule, not all the distinctions of the overall classification will be required: this does not mean that in such cases the environment should simply be specified by listing emic phonological boundary symbols; naturally generalities of ms. rule environments expressible in ms. terms may be re-expressed in terms of a hierarchical organization of phonological boundaries (cp. the concept of 'rule-ranking').

Phonological boundaries can vary quite considerably in the ms. homogeneity of their members; some may correlate one-for-one with

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rules $z \rightarrow r \,/\, \_\_\_\_\#$ and $t \rightarrow s \,/\, \_\_\_\__{\text{dative sing.}}[i$, are synchronically formulable as $C \rightarrow r \,/\, \_\_\_\_\#$ and $t \rightarrow s \,/\, \_\_\_\__{\text{any suffix}}[i$, with extensive vacuous applications: in the former case phonological naturalness is often a guide, in the latter hardly if ever; in both cases a maximally general specification may imply a significantly false prediction for loans and new formations. At all events, decisions made in the formulation of the P-rules on questions of generality will not affect the *number* of different phonological boundaries posited.

independently motivated ms. categories, others may contain members which are morphosyntactically heterogeneous.[6] The formal mechanisms of boundary assignment have been used to reflect not only the direct regularity of the former but also what might be considered the underlying regularity of the latter; this is possible when boundary assignment is handled on an item and process rather than an item and arrangement basis (cp. the Chomsky-Halle 'readjustment' rules). In order to achieve homogeneity of the ms. boundary sequences correlated with any particular phonological boundary, aberrant ms. boundary sequences may be given an underlying assignment to a different phonological boundary involving less discrepant ms. boundary sequences, and then, so as to achieve the correct correlation with the phonology, a subsidiary mutation for the phonological boundary is written. Such a situation is of course also open to treatment by diacritic exception features, if it is less general.

To sum up: a grammar can produce correct outputs without phonological boundaries simply by a direct correlation of the rules of the phonology with the boundary sequences of the morphosyntax. Phonological boundaries capture generalities about correlations between phonological rules and ms. boundary sequences. Other organizations capture certain similar generalizations, but phonological boundaries capture some generalizations that all other organizations fail to capture, and there are no generalizations captured by other organizations that cannot also be effectively expressed in terms of phonological boundaries.

Metaformalistic considerations. Vachek (1964) and other linguists have assumed that an abstract morpheme cohesion parameter underlies phonological boundary distinctions and is reflected in the different degrees to which morphemes are phonologically integrated. Phonological boundaries would thus either be or be motivated by phonologically relevant segmentations of the abstract morpheme cohesion parameter, which could be viewed as providing a more substantive and linguistic basis for the at present purely classificatory/organizational phonological boundary. This is a notion made more attractive by diachrony in general, which shows us that some ms. units cohere more than others; and in certain cases phonological boundary distinctions may indeed reflect different diachronic strata. But such a cohesion parameter must remain a speculative assumption rather far removed from empirical investigation, and the relation between ms. boundaries and the 'integratory' effects of P-rules (insofar as it is possible to assess the latter objectively) does not seem to be such that contrasts between phonological boundaries can be interpreted consistently as differences in morpheme cohesion: e.g. in Greek ἀκμή vs. δεδεγμένος, σταθμός vs. πεπεισμένος, Sanskrit *namatam* vs. *named asame*, the lower ranked boundary blocks the assimilation rule affecting the higher ranked boundary.

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[6] For instance, in Greek, unless a ms. feature [restricted word order] be thought appropriate, the clitic boundary will have such disparate members as: conjunctions, pronouns, articles, prepositions, adverbs, modal particles, 3rd sg. verb *to be*, numerals.

One interpretation of the function in language of boundaries is that they are "Grenzsignale" (Trubetzkoy 1969). It should be evident that the number of phonological boundaries posited for a language represent the (maximum) number of different "Grenzen" that can be signalled by the phonology. But many linguists apparently consider that while some morphosyntactically conditioned phonological rules do signal beginnings and ends, irrespective of the distance of mutated segments from the boundary, others, just like morphologized rules proper, evidently signal the ms. category and not its delimitation. It is not clear whether this distinction could be pursued to the point of restricting the use of boundaries to the major hierarchically ranked categories, such as morpheme, word, etc. On the latter highly restrictive view, the categorial information conveyed by boundaries would differ from the categorial information otherwise conveyed in that the former could only refer to very general ms. categories standing in a relation of containment (constitute : constituent)[7] to each other. In any case, the formal organization of the correlations between the phonology and the morphosyntax that has been outlined in the preceding section would be theoretically applicable to both boundaries and ms. categories specified without reference to their delimitation.

The formal difference between emic boundary symbols and direct specification of ms. categories (either by simple listing or by a boundary-type emic classification) could be considered to reflect the following assumptions: a) there is a difference in function between phonological rules signalling ends and beginnings, and phonological rules signalling category distinctions (other than those constitute-constituent distinctions just described, at least); b) that this functional difference is reflected by different principles of grammatical organization (b. does not, of course, automatically follow from a.).

2. Boundaries in the literature

1. *The first concrete phonology.* When reading the structuralist literature on juncture (most of the relevant references are to be found in Lehiste 1960), one is struck by the lack of an explicit recognition of the dual, if inseparable, functions of 'juncture'. On the one hand juncture can have a delimiting function, i.e. it can signify the bounds of the unit on which the phonological description, or any particular section thereof, is primarily focused. (These bounds can theoretically

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[7] See Juilland (1961:29-32).

be defined in purely phonological, purely morphosyntactic or phonosyntactic terms, e.g. syllables, roots, phonological words respectively). As a phonemicization of beginning/end of utterance or syllable or word, the juncture has a *delimiting* function, and it was early conceived of as an eme in the string with the implementation "pause" or [−segment].

Once the juncture is interpreted as an eme, it can assume, in common with all emes, the function of acting as an environment for the prediction of allophones. This *specifying* function of juncture was the more readily accepted because it obviated the necessity of positing separate boundary contiguous phonemes. The latter function gained importance when it became necessary to account for the same (as it was thought) allophones when they appeared not adjacent to pause, i.e. when there was no phonological environment by which to predict the allophones. In this case the required environment was inserted, and a justification was found on non-phonological grounds, namely that utterances semantically identical to the strings bounded by the inserted junctures could appear between pauses in other syntactic environments and in other phonostyles.[8] In point of fact, from a strictly autonomous point of view, this procedure is quite unjustifiable. A non-autonomous criterion of identification has been introduced here under the guise of the zero allophone, since, if we take the sequences $\alpha\emptyset$, α' , without such a criterion, the zero that serves as the environment for the prediction of allophone α cannot be distinct from the zero that serves as the environment for the prediction of allophone α'.

Let us take the semantically distinctive (i.e. not freely varying) sequences [ab] and [cb] and [cd]: the simple analysis is that *a* : *c* is a phonemic opposition, and we phonemicize /ab/, /cb/. If we wish to make *a* and *c* allophones of /a/, then we must have a distinctive environment for their prediction. But *b* is phonetically identical in both occurrences. Phonetically identical segments can be classified as allophones of different phonemes (not at all in some structural theories, and in others) only as overlapping allophones, in which case they must occur in distinctive environments, or as implementations of an archiphoneme, which is precluded by the occurrence of *cd*, since archiphonemes obviously cannot have distinctive implementations in the same environment. Thus all ways lead back to the original conclusion that *a* : *c* is a distinctive opposition, which is logically evident anyway, since the commutation test could hardly have arisen if it were satisfactory procedure to posit identical phonemicizations (/ab/ and /ab/) of sequences that are both phonetically and semantically distinct. If in the above example *ab* is replaced by $\alpha\emptyset$, *cb* by $\alpha'\emptyset$ and *cd* by α'pause, where $\emptyset = {\sim}$pause, it becomes clear that either α and α' are different phonemes or the distinctivity is due to some item not included in the transcription, i.e. a grammatical boundary.

Thus, viewed without the prejudices of the era, the positing of juncture at 'zero pause' was mistaken structural practice only in autonomous terms, since the segmental allophones which were the motivation for positing juncture at 'zero pause' had a distinctive environment in the string all along; since this environment was non-phonological, if it was to be non-spurious, it could only be the ms. boundary sequence (see Pike 1952), directly or better (as explained in the theoretical section of this paper) with phonologically motivated reclassification.

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[8] Both contexts are confusing, since "other syntactic environments" could mean 'cooccurring with other junctures' (cp. Trager's syntactically based junctures), and "in other phonostyles" might rather suggest a 'phonostyle translation' rule deleting the juncture in the more allegro style, a typical problem with free variation and its treatment during the structuralist period.

A solution to the problem of predicting the posited allophones of juncture was sought by some linguists (e.g. Wells 1947) in the use of [±end of utterance] as an environment: juncture → pause / ___ + end of utterance, juncture → ~pause / ___ ~end of utterance. This smacks of circularity with an autonomous definition of end of utterance and in any case goes no way to solving the main problem of justifying the location of juncture at various points in the string. 'End of utterance' serves as the environment for the prediction of the allophones (pause and non-pause) of the juncture phonemes, which in turn serve as the environment for the prediction of the segmental allophones (the phonemic status of which would result in an undesirable complication of the inventory): the result is simply to leave the whole question where it began. If the segmental differences are not to produce additional segmental phonemes, a juncture is required, but (in an autonomous theory of phonology), as just pointed out, there must be some phonetic implementation of the juncture (other than the segmental allophones) to justify its appearance in the transcription.

Indeed there arose a controversy as to what were the phonetic properties of juncture or even whether there were any at all. In this debate one can recognize two extremes: for Harris (1951) juncture is a zero phoneme with no properties other than that of serving as an environment for allophonic rules; in this sense it is like its generative successor, the phonological boundary. For Hockett (1949, 1955; see also Trager 1972:36) juncture is a class of allojunctures defined by itemizing any and all phonetic phenomena desired for simplification of the inventory. The middle ground was occupied by linguists who tried to sort out the characteristic phonetic properties implementing the juncture phoneme from the properties of the surrounding segmental allophones (e.g. Hill 1958). Harris' position has been discussed above; Hockett's gives rise to some problems over heterogeneity of the phonetic implementations of juncture, and particularly with the linearity condition, and the discrepancy between natural phonetic segmentation and Hockett's biphonemic analysis of boundary contiguous allophones. To avoid the latter the phonetic implementations of juncture would have to be considered features of the segment rather than separate phonemes, which would result in just the additions to the inventory of phonemes which the juncture was designed to avoid.

It is often the case that the segmental allophonic rules at compound boundaries are not entirely identical to those at word boundaries, in which case a second, distinct juncture is required, as Harris realized. It was but a short step to extend this procedure and posit further junctures at other points in the string to simplify the phonemic inventory. By logical criteria, in an autonomous framework, this procedure is entirely circular, since the phonemic environment for the allophones predicted by the different junctures is again fictitious. Failure to realize this led to patent abuses of juncture as a descriptive device, for instance Latin /ak+wa/, suggested by Hill (1954). Such "extravagances" (Wells 1947) were criticized well before the end of the structuralist period: "linguists find themselves tempted to institute 'junctures' simply as notational devices" (Wells 1947). The problem for the autonomous phonemicists was that, ms. correlates being outlawed, it was necessary to find "phonetic warrant[s]" (Wells) for junctures; whence arose the debate concerning the phonetic implementations of juncture, which we have already discussed.

If a juncture may be placed between any two phonemes in the string for the purpose of producing an economy in the inventory of phonemes, it is easy to see how a reductio ad absurdum of this procedure could lead to reanalyzing m n-ary correlations so as to reduce mn phonemes to m phonemes + $n-1$ junctures.[9]

Since no satisfactory constraint was found for juncture location in purely autonomous terms, logically the next step was in the same direction as Pike (1952), namely the requirement of a correlation between junctures and ms. boundary sequences (Chomsky et al. 1956).

If junctures do not have phonetic properties of their own, then they must be diacritics for predicting features. Moreover, in the absence of any criterion (such as correlation with ms. boundaries) for deciding whether to posit diacritic + rule or additional phoneme, they are arbitrary diacritics. On the basis of our exposition in the theoretical section of this paper, it may be seen that the structuralist requirement of autonomy has forced an interpretation of phonological boundaries according to the diacritic model, i.e. as distinctive sets of allophonic rules.[10]

Another (not very widespread) use for junctures during the structuralist period was to simplify phonotactic statements (Hill 1954). Insofar as phonemes are defined as the sum of their oppositions, the assumption of a 'juncture' environment, by reducing the sum of occurring oppositions and thus conformably modifying the (distributional) defintion of the constituents of those oppositions, has the effect of removing a distinctive phonological feature or matrix of features from the overall system or from a phonologically defined sub-system (Phoneme occurs in system → phoneme does not occur in system, merely (allophone of) another phoneme). The principle of economy of phonemes may be extended to economy of clusters: phoneme occurs in sub-system → phoneme does not occur in sub-system, merely archiphoneme or some higher level of redundancy. The difference between the two lies in whether the phoneme exists in environments other than the one being differentiated into two by insertion of a juncture; it is a difference between distribution and inventory. In both cases the contrast between the feature values differentiating two matrices is abolished in a sub-system; it is only that in the one case this holds for the overall system too, in the other it does not. Indeed, a less physical and more puristically distributional view of the

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[9] Indeed, if sequences of junctures are permitted before and after any segment, one could replace

$$m\left(\sum_{l=o}^{l_{max}} n^{l}\right)^{2}$$

phonemes by m phonemes and $n+1$ junctures, if a maximum number of junctures l_{max} is permitted before and after a phoneme (an interjuncture juncture being required to associate the substrings of contiguous junctures with the left and right phonemes in the string).

[10] Use of junctures could be viewed as involving mixing of levels, not only on the environment model by which morphosyntactic information is included in the phonemic transcription, but also (by a sort of inverse 'globality') on the diacritic model by which allophonic information would be included in the phonemic transcription (i.e. the lower level automatic and rule governed with the higher level distinctive).

phoneme might have lead structuralists to attach more importance to juncture as a diacritic environment for allophone prediction and less to juncture as a phonological segment with dubious physical attributes such as zero allophones of pause.

In the matter of non-allophonic phonological alternations, the concept of the juncture was utilized by Harris (1951) in a discussion that makes very instructive reading in the light of the problems that were to arise in the post-structuralist period.[11]

1. Alternations that are not boundary sensitive are accounted for by a phonological rule the mutandum of which is a sequence defined as non-occurring by the autonomous phonotactics.

2. Alternations that occur in the environment of particular morphemes only are accounted for by morphophonological rules operating in the environment of, and "consider[ed] . . . part of the phonemic content of" (1951:222) the list of morphemes in question (e.g. Engl. *-ity*). The set of relevant morphophonological rules may be emicized in the morphophonemic transcription of the relevant morphemes (1951:229 ∺ = *k* → *s*, *ey* → *æ*) as a separate symbol, /∺ity/.

3. As for 2. except that the list of motivating morphemes constitutes a general class (1951:242). This situation is accounted for by positing a MORPHOPHONEMIC JUNCTURE that "would be the initial part of the morphophonemic spelling of each of these suffixes" (1951:242). It is important to note that this juncture has the function of uniting the various morphophonological rules into a single class on the basis of shared morphosyntactic environments, cp. the autonomous juncture.

4. When the conflicting alternations are in the conditioned rather than in the conditoning morpheme, (*wives* but *fifes*), Harris posits a morphophoneme; this analysis was "useful in that it marked for easy notice the morphemes in which the alternation took place" (1951:241). The morphophonene is an emicization of the abstract property of class membership defined by each set of alternants distinctive in the same environment. A morphophonological rule is then given for the phonemic implementations of the morphophoneme. Thus the distinctiveness is supposed to lie in the mutandum (the morphophoneme) rather than in the environment (boundary) of the rule. This amounts to the claim that in a morphosyntactic boundary sequence, (e.g. $]_{\text{stem affix}}[$), if the bracket of the conditioning constituent is an environment in a morphophonological rule, then solutions 2. and 3. are suitable, but if it is the bracket of the conditioned constituent that provides the requisite morphosyntactic information for the proper functioning of the rule, then 4. is correct.

In Harris' account we can clearly see the forerunner of the farrago of competing descriptive devices we will encounter so prominently in the abstract phonology. Making 1. a separate category anticipates the general basis for the natural generative distinction between morphologized and non-morphologized rules.

We can now turn to the use of junctures in external sandhi: Trager wrote (1962:15) that "the term *juncture* was chosen because it dealt with phenomena at a point of joining (of morphemes or words or the like)." One of the reasons why the juncture principle was here too invoked less extensively than one might have

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[11] It is also interesting that Harris invokes "simplicity" (1951:241), "generality" (1951:223, 239) and "economy" (1951:238, 239), all the criteria which were the basic rules of rational procedure through most of the classical generative period.

expected during the structuralist period is simply that little attempt was then (as now) made to account for the phonetic detail of syntactically motivated allophonic rules (mainly affecting suprasegmentals); but Trager (1972:45) has five 'junctures' in all. Apart from this, it is important to realize the restricted objectives of autonomous analysis. It is not the objective of autonomous phonological analysis, by definition, to account for alternations that can be established by reference only to the first articulation of language, and an autonomous analysis is thus not concerned with phonemic alternations arising either when words are combined into sentences, or when morphemes are combined into words. External sandhi rules, like morphophonemic rules, are non-autonomous, even if they are sometimes reflected autonomously in complex neutralization and defective distribution rules.[12] An autonomous analysis will always tell you what you cannot get, but not necessarily by what process you removed it (see Devine and Stephens 1974): thus sandhi rules do not play a part in the theoretical discussion of phonemic juncture during the structuralist period.

2. *The Abstract Phonology.* During the classical generative period there was little systematic treatment of the basic principles of boundary theory, though, of course, one can find considerable incidental discussion of more restricted problems: formal mechanisms, adjustment rules, and constraints, and even the functions of boundaries in phonological rules were topics for some attention: but all of this took place within a theoretical framework which seemed content to relegate boundaries to a sort of ill-defined intermundia between the syntax and the phonology; a conviction that boundaries in phonology are not simply the morphosyntactic boundaries (cf. boundary insertion or readjustment rules) appears to have been coupled with a certain reluctance, at least for some, to grant them full phonological status (cf. the terminology 'boundaries in phonology' rather than simply 'phonological boundaries'). At worst this encouraged a sort of inductive approach proceeding from possibilities more or less implicit in an unquestioned theoretical framework and from diverse descriptive practices, partly intuitive, partly ad hoc. Such fragmentization in turn obscured basic issues such as the criteria for choosing among competing descriptive devices for satisfying what are, in part, similar descriptive requirements. Questions concerning the use of lexical, morphological, syntactic, or even semantic or other diacritic features; or the enumeration of individual morphemes in phonological rules — such questions are critically related to the number and distribution of boundaries in phonology and yet were hardly raised in discussions of boundaries; and conversely diacritics were frequently posited with no overt reference to any potential effect of this on the boundary system. All this was compounded by a widespread reluctance to give an explicit formulation to the substantive presuppositions that presumably underlie the various schemes proposed. For instance, we find the affixes *-ic, -id, -ish* listed in the environment of rule 20.iv in SPE 241; Sommerstein (1973) distinguishes Greek sigmas by the feature [aorist] and invokes a feature [+factual]; there is a striking incomunicabilità when Stanley (1973) writes: "to prove that *n* different

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[12] An autonomous phonology might include a rule predicting Sanskrit visarga or voice assimilation in stops, but it would not be concerned with *vijñaya idam* → *vijñayedam*, since *-a#i-* is an occurring sequence (cp. *nagara iha* < *-e#i-*).

types of boundaries are phonologically necessary, we should have to find a sequence of underlying phonological segments XY that showed up in *n* different ways phonetically, depending on what kind of morphological break occurred between X and Y", without mentioning rule diacritics, while Kisseberth (1970) and Coats (1970) evolved powerful diacritic devices for the lexicon with no suggestion that boundaries could in anyway be relevant to the topic. Yet another procedure is recommended by Postal (1968:130) who distinguishes general morpheme features from completely arbitrary "exception" features on the grounds that the former "are not posited for special behavior under a single rule, but for correlated special behavior under a number of rules (cf. the discussion of boundaries on the diacritic model in section 1). That the problem is not merely one of inexplicitness over generally agreed criteria is quite clear, e.g., from the vicissitudes of English "velar softening", where the *same* rule is given *different* analyses, running the whole circle from SPE (lexical diacritics) to Schane (1973 — phonological boundaries in rule environment) to Hyman (1975 — list of morphemes in rule environment).

The prevailing occupation with only the pragmatics of the functioning of boundaries in phonology as 'markers' even led to the suggestion that they may be superfluous: Stanley and Shibatani (Shibatani 1972) appear to have thought that once some device is found to preserve syntactic brackets as far along the derivation as desired (e.g. by "checking" rather than erasing them after the application of cyclic rules), all phonological rules might then refer directly to such information, so that "there is no need to introduce boundary markers at all". This would answer the critical questions 1. and 2. of section 1, but the entire problem of boundaries suffers an unwarranted trivialization, if they are viewed as finding their origin and support and a justification for their separate existence vis-à-vis morphological or syntactic brackets solely in a mechanical interpretation of the functioning of the cycle! Saltarelli (1970), on the other hand, considered that "speech events are represented as sequences of segments and boundaries", and that "syntactic boundary markers are replaced by phonological ones, when significant, or deleted", and that the two principles just cited are "universals of the general theory of phonology assumed". While Bierwisch (1966) treated at considerable length phonological phrases, intonation, clisis, and the like in German within a generative framework, Chomsky and Halle (1968) excluded from discussion the more substantive questions involved in the formulation of "readjustment rules", i.e. the relation of the independently defined morphosyntactic classes and their phonologically relevant regroupings that were to be treated in terms of boundaries — a strategy greatly facilitated by the invocation of their "competence-performance" distinction: ". . . it can certainly be argued plausibly that this 'flattening' of the surface structure is simply a performance factor . . . Hence it can be argued that these problems do not belong to grammar — to the theory of competence — at all" (1968:372). Such problems were to become an important area of conflict in the classical generative application of the boundary device (see below on boundary mutation). On occasion elegant correspondences were found between the demands of the phonology and the independently hypothesized notational devices of the syntax, as e.g. by Selkirk (1974) on French liaison; yet on the other hand, sometimes the discrepancies appeared so great that modifications were introduced into the transformational analysis of the offending syntactic constructions, as e.g. Sommerstein (1973) on Greek co-ordinate phrases.

The greatest concern of classical generative phonologists was probably the attempt to bring order and generality to the boundary elements within their formalistic framework; leading concepts here were introduced by McCawley (1968) in terms of "juncture hierarchy" and "rule rank". These notions were extended by Stanley (1973), who attempted to establish a typology of the "sorts of interaction between boundaries and phonological rules" from a close analysis of phenomena observed in SPE and Stanley (1969). Stanley recognizes three different types within his typology: "(a) a rule may apply generally except when blocked by a strong boundary in the interior of its environment; (b) a rule may apply only when a particular boundary type is present; and (c) a rule may apply only when a boundary of a certain type or stronger appears at the (right or left) end point of the environment of the rule." It is not clear why certain logical possibilities (some of which have in fact been employed by other phonologists) are excluded; for example rules could be "blocked" by boundaries from both "above" and "below" a certain portion of the strength hierarchy, and rules could require a specific portion of the hierarchy for their application (both as perhaps seen in sandhi phenomena). Likewise it is not explained why the analysis is carried out in terms of the application or non-application of individual rules, i.e. why it is presupposed that rules can always be classed as regularly applying or regularly not applying, rather than competing.

Morphosyntactic class labels, phonological boundaries, rule assigned [−rule] features and lexical diacritic features were on occasion all used to account for a single morphophonemic alternation: Brasington (1970) proposed a rule for Catalan: "word final dental nasals are deleted"; but for this rule to function properly he had to set up the following scheme:

$$\begin{array}{ll} n-1 & [\quad] \rightarrow [-\text{rule } n] \,/\, [\text{Verb}] \\ n & [\text{dental nasal}] \rightarrow \emptyset \,/\, \underline{\qquad}\,\# \end{array}$$

and then lexically mark certain verbs, such as *tenir*, as exceptions to the rule numbered n−1, which assigned a minus rule feature for the rule which deleted final dental nasals (numbered rule n). Here Brasington was evidently making the implicit assertion that the ms. class of Verbs should be given a [−rule] feature in order to preserve the generality of the # boundary and obviate a complex boundary system such as

$$\begin{bmatrix}+\text{stem}\\+\text{verb}\end{bmatrix} \quad \text{vs.} \quad \begin{bmatrix}+\text{stem}\\-\text{verb}\end{bmatrix}$$

with the latter attached to certain exceptional verbs. The procedure here was of course equivalent to a treatment by means of subsidiary boundary mutation rules which could have been used to simplify the boundary types. The choice of descriptive devices in this case may well have reflected the view of boundaries discussed in section 1, which considers them as basically delimitational devices, distinct functionally and psychologically from devices designed to convey information about ms. categorization.

Stanley (1973) in the "New Approach" section of his paper worked out a scheme which suggests a very different view of boundaries. To start with, #'s were assigned to the beginning and end of all stems; these were then "weakened" to various degrees depending on the affix class to which the relevant affix belongs. Problems of the ms. composition of these affix classes, their generality and homogeneity were not discussed. But a very powerful device was introduced which would have permitted the treatment of all morphophonemic alternations that could in any way be associated with any ms. seam whatsoever in terms of boundaries, rather than diacritics, or ms. listing, namely the transformation of affix class membership for particular affixes in the environment of different stems (or stem classes?): "in certain cases different instances of the same affix morpheme will fall into different classes, depending on the stem." This device seems to imply that affix classes were to be viewed as intensionally defined by some property rather than merely extensionally, for otherwise these classes would have appeared hopelessly arbitrary; the criterion for the organization of affixes into Stanley's classes is, or correlates with, phonological distinctiveness. In fact this device allowed Stanley to preserve the formal association of boundaries with affixes rather than stems (a preference we have noted earlier) and at the same time to extend boundary treatment to cases that would have required (as noted in section 1) diacritics or some other device if boundaries were constrained from referring to specific morphemes. Unfortunately Stanley does not tell us whether this potential would have been fully exploited or not. At any rate this was hardly a delimitational view of boundaries. Stanley clearly intended the property of morpheme cohesion as the defining property for his classes, since cohesion might easily be viewed as a function of both the stem and affix involved: "class membership is determined by how closely the affix combines phonologically with adjacent material" (1973:203). Such a view is considerably removed from the purely formalistic treatment of boundaries by the classical readjustment rules it is intended to replace, but it is characteristic that such basic interpretive issues and their psychological implications received little treatment.

As was already clear from Harris's fundamental discussion, there was a strong feeling that junctures or boundaries were unsuitable for exceptions involving root morphemes rather than affixes. This seemed to be true even when the class of exceptions was quite large, e.g. when a significant number of roots failed to motivate (i.e. to act as a conditioning environment for) a rule (or vice versa underwent or motivated special rules that others did not). This differential treatment of roots and affixes is also found in the natural generative preference for listing morphological environments in morphologized rules, but not listing radical morphemes in such rules — the latter being handled by marking in the lexicon. But not all generative phonologists apparently shared these scruples; Hoard (1973) e.g. posited a # boundary after the Sanskrit root *dhadh* (on the grounds that it was not subject to Bartholomae's Law but was, on Hoard's analysis, subject to certain rules that other roots were not) when this root was followed by verbal endings beginning with *t* and *th*, but not, however, when e.g. the 1st person singular middle *-e* ending followed. Most other roots were considered to have had a plus boundary before all endings. However, other generativists clearly did not approve of such descriptive techniques; for in the same volume Phelps (1975) preferred to mark *dhadh* diacritically as an exception to Bartholomae's Law, and cited Hoard's own principle (1972) forbidding readjustment rules with phonological environments. This dictum hardly seems to have been decisive, since in this case all the relevant environments for # rather than plus could have been formulated in purely morphological terms. Strangely the debate over the dictum (SPE 375) that only mutanda, and not environments, may be marked as exceptions largely ignored the possible relevance of boundaries. Coats (1970) proposed the use of rule environment features which covered not only the problematic cases of exceptional roots which fail to serve as environments for rules, but also cases of affixes and sets of affixes where boundaries would have been more freely used: e.g. his case from Russian where the rule k → č does not apply before certain suffixes was discussed from the point of view of "alphabet features" (1970:120) and minus rule environment features (1970:133), but not in relation to boundaries. In these treatments the issues singled out for discussion often appear trivial when compared to those raised by the theoretical framework taken for granted in the analysis.

We have already remarked that ms. categories are sometimes grouped by the phonology into classes that are, from a purely ms. point of view, unwarranted. On an item and arrangement model the phonological boundaries are correlated with the ms. boundaries by readjustment rules. On an item and process model, the readjustment rules can be simplified and made to produce more straightforward correlations if the subsidiary device of boundary mutation is used: boundary mutation had some vogue during the classical generative period. (It is to be distinguished, at least formally, from Stanley's affix class membership transformation, in that the former mutates phonological boundaries while the latter operates directly on one of the two ms. classes that come together at a ms. seam.) Let A and M be different sets of ms. boundary sequences having respectively the subsets $\alpha\ \beta\ \gamma\ \delta$ and $\mu\ \nu\ \pi$; and let I and II be two sets of at least partially contradictory P-rules (1, 3, 5) and (2, 4, 6) where, since 2 may mean 1 does not apply, or vice versa, either may be a vacuous rule; let the ms. boundary sequences $\alpha\,\beta\,\gamma$ induce P-rules I and the sequences $\delta\ \mu\ \nu\ \pi$ induce P-rules II. The provisional item and arrangement organization of these data will involve phonological boundary assignment as follows:

$$\text{phonological boundary 1:}\quad \begin{bmatrix}\alpha\\ \beta\\ \gamma\end{bmatrix} \text{ or } \begin{bmatrix}\text{A}\\ -\delta\end{bmatrix} \rightarrow \text{rules I}$$

$$\text{phonological boundary 2:}\quad \begin{bmatrix}\delta\\ \text{M}\end{bmatrix} \rightarrow \text{rules II}$$

The item and process reorganization allows the generality to be expressed by the relevant phonological boundary assignment rules, and the simple boundary mutation can be considered as effecting a subsidiary modification of those rules, the aberrant ms. boundary sequence being eliminated from the matrix of phonological boundary 1 and added to that of phonological boundary 2:

$$\delta\ (< \text{A}) \rightarrow \text{M}$$

These effects correlate well with the complexity typical of exceptions. However the formalism associated with phonological boundary mutation in abstract phonology (e.g. Selkirk 1974; Sag 1974), by simply using emes (+ → #, ## → #, etc.), unfortunately failed to represent the undeniable fact that mutating a boundary (and changing the phonological boundary ranking of a P-rule) must inevitably involve modification of the nature of both phonological boundaries involved.

A less straightforward form of boundary mutation is context-sensitive boundary mutation. Let us revise our formalized example so that δ is characterized by the P-rule set I except that it has 6 instead of 5: then we must have a mutation rule to generate a new phonological boundary, which is inevitably required by the third class set up by the new combination of P-rules (1, 3, 6), even if the mutation device obscures this fact by rendering a separate symbol unnecessary. The rule would have the form:

$$\delta\ (< \mathrm{A}) \rightarrow \mathrm{M}\ /\ \text{rules 5-6}$$

or, on the 'diacritic model' (see section 1):

$$\mathrm{I} \rightarrow +6,\ -5\ /\ \delta$$

Context sensitive boundary mutation is exemplified by Sanskrit *haviḥṣu*, which was a topic of discussion during the classical generative period. If we grant for the moment that the visarga rule is not characteristic of intermorphemic phonological boundary (a claim unrelated to the claim that the rule is characteristic of word phonological boundary), then the boundary sequence associated with the *-su* inflection induces some of the rules typically associated with # but not with + (e.g. *s* → *ḥ*) and other rules typically associated with + but not with # (e.g. cerebralization: *s* → *ṣ* — which is not an external sandhi rule, with the exception of tightly knit phrases in Vedic); this point was overlooked by Sag (1974), so that a different phonological boundary appears at *-sú* ms. boundary sequences than at other inflectional or word boundaries.

One simple alternative to the above that eventually suggested itself as a device for capturing directly the relation between morphological process and liability to certain P-rules is that of ordering morphological operations in the phonological derivation relative to the critical P-rules; indeed arguments have been made for this procedure on independent grounds, as e.g. in the case of Tagalog reduplication (for discussion of the interaction of morphological and phonological rules see Kisseberth and Abasheikh 1974 and Anderson 1975). At least certain kinds of phonological boundary opposition can be viewed as instructions given by the morphology to enter forms produced by morphological operations into the phonological derivation as units (N.B.) at points before and, respectively, after one of a pair of juncturally opposed rules. For instance in Greek φροίμιον versus προοίμιον (cf. Brame's *Prohibition* versus *prohibition* 1974), the latter may be considered exempt from the extra rules undergone by the former in that the morphological compounding operation did not unite the prefix with the noun until after the application of the elision and aspiration rules. This may or may not be reflected in a difference in the constituent structure bracketing of the compound; this principle is less apt if ultimately morphological analysis could lead back to identical constituent structure or when there is a ternary rather than binary phonological boundary distinction, as possibly in Greek compounds: κακουργία (contraction), κακεργέτης (elision, late!), κακοέπεια (Suid., cf. ὀρθοεπεία — hiatus). Similarly in the oscillation of Sanskrit compounds with respect to cerebralization: the type *abhi-ṣic* could be formed before the cerebralization rule, while compounds exempt from cerebralization (type *prati-sad*) could be formed after it in the phonological derivation.

Unfortunately, this approach suffers from serious defects and cannot be generalized to an interpretation of all phonological boundary phenomena. First of all, on a linear ordering hypothesis (as opposed to a local ordering hypothesis) for P-rules, it fails where the morphologically produced form must appear as a phonological unit for some earlier rule but not for some later rule. Consider Latin *quīntus* (*k*^{w}*ink*^{w}*-tus*) 'fifth' ($k^{w} \rightarrow k \rightarrow \emptyset$, cf. *ultus, fultus, tortus*) where the suffix seems to cohere more closely with the stem than does the suffix of the participles *sānctus* (*sank-tus*) 'decreed sacred', *cīnctus* (*king-tus*) 'surrounded', *ūnctus* (*ung*^{w}*-tus*) 'anointed'. It is a general rule moreover that vowels are lengthened before *nkt*, and this rule has produced the long vowel of *quīntus* as well as that of *cīnctus*, etc., so that the vowel lengthening rule must have its (natural) ordering before the *k*-deletion rule; i.e. *king-tus* must have entered the derivation before the assimilation and lengthening rules just as *kwink*^{w}*-tus*, but not entered until after the (later) *k*-deletion rule. The above interpretation of phonological boundaries as ordering of morphological operations relative to critical P-rules would have to be complicated to permit not only insertion of a form but also withdrawal (and re-insertion) to handle such cases.[13] The general failure of this interpretation follows of course from the fact that there is no necessary correlation between the order of P-rules in the derivation (from earlier to later) and the hierarchical arrangement of ms. boundary sequences from more to less cohesive.

A local ordering hypothesis, according to which the ordering relation between rules is *not* transitive, and explicit ordering restrictions affect only the rules mentioned, would of course remove the basis of the above objection, but the initial intuitive appeal of the suggestion as an interpretation of boundaries would seem to be weakened, since phonological boundary induced restrictions on ordering would come to resemble lists of morphological exceptions to P-rules. In any case the interpretation of phonological boundaries as relative ordering instructions for morphological processes fails in cases where a form which would naturally be interpreted as showing no morphological boundary sequence at all fails to undergo certain P-rules; e.g. in Greek ἀκμή versus πέπλεγμαι ($k \rightarrow g$ / ____]m), since there is no morphological operation to be ordered, whether linearly or locally.

We have noted the failure of simple boundary mutation to handle cases such as Skt. *haviḥsu*, since a third phonological boundary is required, necessitating the formalism of context-sensitive boundary mutation. Within the framework of abstract phonology the result is an overlapping of the ranking of (certain) internal and external sandhi rules: cerebralization from + to, say, =, and visarga from = to ## (and similarly in the case of *cīnctus* above). There is, however, another approach that could greatly reduce the number of phonological boundaries overtly specified and simplify the boundary assignment and rule ranking, namely to order boundary mutation in the phonological derivation relative to critical rules, thereby eliminating the need for context sensitive phonological boundary mutation: thus + → # / specified ms. boundary sequences could be ordered between internal and external sandhi, or, for the Latin example, before *k*-deletion. There may of course be difficulties which would require multiple applications of variably ordered boundary mutation. Such a procedure is, however, apart from questions of naturalness, open to great abuse, since in theory it would be possible to employ only two phonological boundaries and handle all deviations through a complex series of boundary flip-flop rules at many different points in the derivation. The result, however, would be equivalent to listing ms. brackets in the phonological rules or specifying in the morphology which P-rules function at which ms. brackets. Or again to carry this reductio even further, one could get by with only one phonological boundary and zero boundary, using repeated phonological boundary deletion and insertion at various points to achieve the correct output in cases of phonological boundary opposition.

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[13] Since *k*-deletion stands in a counter bleeding relation to vowel lengthening, it is possible (according to one suggestion: Koutsoudas et al. 1974) to dispense with any order of relative application for such rules and regard them as applying simultaneously rather than sequentially. Any departure from the principle of sequentiality would further reduce the usefulness of this interpretation: a morphological operation cannot occur before one and after another of a set of simultaneous rules, but note here the concept of local ordering. On the rule ordering controversy in general see also Ohala (1974).

3. *The second concrete phonology.* For the all-encompassing abstract phonology the boundary was a descriptive device that could appear, where appropriate, in any rule of the phonology. However, for the structuralists and for the natural generative school, distinctions drawn between types of rules are crucial, and, consequently, it is impossible to avoid the question whether the phonological boundary is an appropriate environment in each type of rule. Most structuralists employed junctures in the phonemic transcription but not in the morphophonemic transcription. The natural generative school distinguishes between true phonological boundaries (which appear in what are now called phonological rules) and environments specified in directly morphological terms (which appear in what are now called morphologized rules). Consequently the number of different boundaries posited in the phonology is substantially decreased, and the amount of direct morphological listing is proportionately increased. Indeed, the latter is further augmented by the new constraints against rule ordering and overly abstract representations (constraints which in an abstract phonology could have resulted in even more phonological boundaries).[14]

Thus for natural generative grammar, if morphophonemic rules have environments correlating with morphological boundaries or categories, those environments are stated in morphological terms (as in morphological rules), whereas in the abstract phonology they could be stated in phonological terms (i.e. with phonological boundaries), just like properly phonetic environments. Lexical diacritics are also permitted in natural generative phonology (Hooper 1973:27). In via rules, it is claimed (Hooper 1973:75), there is no ms. environment: in fact, as in the structuralist morphophonemic transcriptions, the lexical lemmata themselves bear the function of providing the ms. environment. On the other hand, it appears from Hooper (1973:57, 1974:167) that the Chomsky-Halle readjusted and phonologized equivalents of the syntactic bracketing, word boundary (##) and clitic boundary (#), are permissible in morphologized rules, but not in purely phonological rules (Hooper 1975:545). It is not clear to us if this implicit distinction between morphological environments (directly listed) and syntactic environments (phonologized into phonological boundaries) is intended or merely the consequence of the still rather fluid state of the theory. In any case, we have as yet seen no explicit discussion of whether the organizing and classifying functions of phonological boundaries (as described above in §1) would be considered to capture real and significant generalizations about the language by natural generative phonologists.

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[14] As clearly seen by Phelps (1975:455 fn.4).

The claim that ms. boundaries cannot appear in true phonological rules should be recognized as the main criterion for distinguishing the latter from morphophonemic rules; in other words, it is not whether a process is allophonic (including low-level production rules) that is critical to the distinction, but rather whether a process depends on purely phonetic conditioning or not. Evidently, therefore, much of the allophonic detail that appears on spectrograms will have to be accounted for in terms of morphologized rules, since beginnings and ends of syntactic units and constituents are critical to the relevant processes. The only way to keep such processes within the category of true phonological rules would be to assume that those beginnings and ends are phonologized at a certain point in the derivation, i.e. that they have an autonomous phonological status as well as a syntactic status; and this, notwithstanding the trivial and formalistic arguments of Pyle (1972), would amount to resuscitating Trager's junctures and the like.

Another old structuralist thesis is apparently revived by Rhodes (1974), who seeks to eliminate boundaries from his natural processes with the device of transderivational constraints: by this device the formulation of natural processes is rendered autonomous at the cost of a rather indirect specification of the location of syntactic boundaries; moreover, since different phonological processes can apply at what are differently ranked syntactic boundaries, and since it would be impractical to distinguish between different types of silence, the labeling, if not the location, of the syntactic brackets will still have to appear in the formulation of boundary sensitive processes.

Anderson, at the Chicago Parasession, wrote that: "*Phonological* rules are those whose environments involve reference only to the phonological composition of the string including boundary elements and possibly reference to major lexical classes . . . *phonetic* rules are those whose environments involve reference only to the phonological/phonetic composition of the string including phonetically realizable (i.e., word or phrase) boundaries . . ." (1974:3). The distinction between "boundary elements" and "phonetically realizable boundaries" seems to presuppose a linearity condition (e.g. # → pause) for boundaries in phonetic rules, since in any other sense all phonologically distinctive boundaries are phonetically realizable; and such a linearity condition ignores all the problems that arose in the structuralist discussion of the zero allophone of pause. If the above is a correct interpretation of the term "phonetically realizable", then it is unclear to what extent the difference between Anderson's position and that of Hooper (Hooper 1975:loc. cit., 1974:loc. cit.) is not merely one of terminology, since both would be allowing boundary elements as traditionally defined in morphophonenic rules but only pause and syllable boundaries in phonetic rules.

It is easy to get the impression from recent natural generative literature that the currently emphasized explanatory power of syllable structure permits various processes to be formulated in autonomously phonetic terms, i.e. it becomes possible to dispense with the non-phonetic boundaries to which the rules of the abstract phonology were sensitive. Substituting syllable boundaries for phonological boundaries such as compound, clitic and word boundaries, merely shunts the statement of the phonosyntactic correlations (indicated by those boundaries) out of the phonological rule and into some other segment of the grammar. Since syllable boundaries sometimes coincide with morpheme boundaries and sometimes do not, and since evident general ties regulate this situation, rules must be written to capture these generalities (whether directly or in terms of the subsidiary resyllabification envisioned by Hooper 1973:103), and these syllable boundary assignment rules will have ms. environments; in fact they may have the same sets of ms. environments as other phonological rules, which is why one used to speak of compound juncture, clitic juncture, etc.[15]

Another device adopted to replace the phonological boundary is the coefficient of consonant strength (see e.g. Vennemann 1974:365); but this strength coefficient correlates very generally with certain ms. boundaries, so that a grammar will want to capture this by a rule assigning the strength coefficients in the various ms. environments, or, if the coefficients are to be part of the lexical representations, by a condition stating the redundancy. In either case, these generalities are evidently part of the speaker's competence, as is apparent from his ability to identify variants of the same segment irrespective of coefficients. It should be noted in passing that failure to recognize the allophonic nature of the rule assigning or stating the distribution of the coefficients in the various ms. environments results in the addition of new segments to the inventory used in the lexical representations, which is of course just what the structuralists invented the juncture to avoid. In any case, here too a loop has been created: the correlations captured by the erstwhile junctures are not eliminated; they are simply shifted from one type of rule to another. The question of whether the juncture is a phonological entity or merely a list of ms. boundary sequences then presents itself as usual. In its diachronic aspect, the natural generative exclusion of even word boundary as an environment for sound change represents a full-circle return to a once well-known position, held, for instance, by Chafe (1959) and dismissed by Postal (1968).

An ingenious way of avoiding some of the complications of abstract phonology without banishing abstract analyses from the domain of the phonology is suggested by Leben and Robinson (1975). In the various forms of generative phonology, the abstract representation of morphemes is given and the surface forms are to be generated, and often boundaries, morphological environments, diacritics, etc. are necessary to achieve the correct result. In the Leben-Robinson 'Upside-down' or interpretive phonology, the surface forms of words are given and the interpretive test lies in the attempt to generate a more abstract representation on which "morphological parsing" is possible; the phonological processes are given in both theories.

Since the myriad complexities of low-level phonetic representations suggest lexical storage at some more economic and abstract level, we shall here discuss the variant of the theory which posits a generative allophony and an interpretive morphophonemics; of course, boundaries, or their equivalent, will be inevitable in the former. We will also assume that there must be a preliminary operation of selecting as candidates for the interpretive test pairs of words that are semantically related in the way prescribed by the morphological rule in question. In interpretive phonology, just as in the structuralist morphophonemic transcriptions, the lemmata themselves are the environments for the application of the phonological rules. In abstract phonology, where two contradictory rules (of which one may be vacuous) applied to phonologically identical strings, it was necessary to specify which of the two rules applied to any particular case; in interpretive phonology this specification is replaced by a trial and error application of each rule that meets the phonological description of the string until the correct rule is found; a rule is judged correct according to the generally, if not always, relatively straightforward criterion that the correct rule produces an increase (or the greatest increase) in phonological similarity between the test words. Therefore, part of the time, inapplicable rules are being applied to the string on a trial basis, and after the "undoing" of each rule applicable at the relevant point in the derivation (whether boundary sensitive or no), a loop must be executed to check its applicability in the derivation (since boundary sensitive rules are not distinguished from exceptionless rules). Consequently, the real question becomes one of the grounds on which the treatment of exceptions in interpretive phonology is superior to that in generative phonology, since in terms of directness and simplicity there seems to be no striking advantage on either side, at least given the more limited objectives of interpretive phonology.

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[15] It is fashionable in some quarters to reinterpret word-final devoicing as, in reality, syllable final. But in Catalan, for instance, this is not feasible (unless rule ordering were admitted) because in certain phonostyles the voiceless stop occurs also with resyllabification, i.e. a word final stop is voiceless even when it is syllable initial.

The elimination of phonological boundaries in interpretive phonology involves the claim that the speaker does not find a way of simplifying the trial and error operations just discussed by associating rules and rule sequences with particular morphological categories.[16] For if a consistent relation were to be set up between morphological categories or boundaries and particular phonological processes, then the rules, whether applied forwards or backwards, must operate with some grammatical device representing that correlation; at this point interpretive phonology would be faced with exactly the same problem as generative phonology, namely whether to list the morphological environments (directly or by lexical diacritics) or to emicize the class with a boundary symbol.

It should be clearly understood that generalizations of a phonological nature are still captured in an interpretive phonology, i.e. rules have phonological environments that would hold if they were applied generatively. Since all generalizations (i.e. all environments, both morphological and phonological) may theoretically be omitted given the basic interpretive principle that rules only apply if they increase similarity between the members of the test pair, it would appear that phonological environments are retained because they make rules natural. However, the refusal to admit any generalizations that are beyond the scope of 'natural' rules amounts to a very strong claim for phonological autonomy in the formulation of morphophonemic rules, and such a claim would rest on the psychological assumption that speakers are unaware of non-phonological generalizations in morphophonemic rules. Thus the issue that divides interpretive and generative phonology is no longer that of *how* to capture the generalizations, but that of *whether* they should be captured at all.

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[16] Since the surface forms are stored in the lexicon, one view of interpretive phonology would be that it finds out *how* forms are related rather than *whether* they are related (the latter being stated by the morphology); it simply captures phonological generalizations obtaining between forms that are known to be morphologically related. If this is so, it might be asked why it should only capture those generalizations, and not also the generalizations arising from the correlation of different phonological processes with different morphological categories. If the grammar is to do the latter also, i.e. if it is part of its task to specify which rules apply to which lexical items, it will need a specifying device by which exceptionality is reflected in additional complexity.

3. Conclusion

It must surely be evident to the reader of the second section of this paper that phonologists did not attain very high standards of scientific adequacy in their discussions of the topic of phonological boundaries. One generally looks in vain for explicit statement of presuppositions, explicit statement of alternative descriptive solutions, explicit statement of criteria for choosing among alternative solutions, explicit justification of those criteria. These were the very requirements that helped to establish Linguistics as a discipline autonomous from traditional philology, yet this particular chapter of phonology is characterized by all the old vices (and few of the old virtues, particularly in the matter of precise attention to philological detail).

Karl Popper writes (1969:38): "criteria of refutation have to be laid down beforehand: it must be agreed which observable situations, if actually observed, mean the theory is refuted." There has been a tendency for linguists to rely ever more heavily on rules of rational procedure by which to develop basic descriptive mechanisms of the grammar; but such rules cannot be a viable substitute for empirical evaluation of those mechanisms if they are not themselves empirically evaluated; and, by and large, they have not been, because of the extreme difficulty of laying down criteria for that task, (although, of course, language must be ultimately explicable in terms of human physiology and psychology). Consequently, anything that follows on the unevaluated basic analytic framework runs the risk of being an exercise in fiction or a mere metaphysical speculation. Since it is not known which generalizations should be captured by a grammar, it is not known that grammars have, or do not have, phonological boundaries. Statements about the nature of boundaries, constraints on their use, and the general explanation of their existence and behaviour are thus statements about and explanations of a possibly real but unproven grammatical entity, and, what is more, are themselves unproven and based on the same set of empirically unevaluated criteria that were used to posit boundaries in the first place.

What has developed is not merely "a theoretical edifice that is enormous, elaborate, and very, very fragile" (Ohala 1974), but also a multiple ramification of competing descriptive devices, considered justified by their proponents merely because[17] they produced the correct output and were more or less consistent with background assumptions; whereas in fact a hypothesis should have empirical consequences different from or in addition to its explanandum. Now it is a commonplace in science that empirical corroboration is often indirect, oblique and incomplete: but in phonology this is the case to a more than usually serious degree, and in practice the inadequacies are compounded by the tendency to deduce test implications only when some neat bit of data from diachrony, acquisition, etc. suggests itself as support. Therefore the Duhem (1906) — Quine (1953) paradox, (which is of no practical consequence in many other sciences), in phonology appears at every step: any fact or phenomenon can ultimately be accommodated within a theory if some other assumption is altered, or tacitly altered, somewhere else in the theory.

Certain parallels suggest themselves between ancient Greek astronomy and present day phonology. Both possess formal devices of great sophistication and intricacy, but both work from a basis of unsubstantiated fundamental principles. For example, Ptolemy was able to give a rigorous geometrical proof of the extensional equivalence of the epicyclic and the eccentric models of the 'motion of the sun'; he went on to adopt the eccentric model on the basis of the rule of rational procedure 'simplest is best', in this case because the eccentric model required the postulation of only one circle, whereas the epicyclic model required two circles. Thus an a priori criterion was used to decide between two hypotheses; but both hypotheses are in fact equally fictitious, the correct model not even being considered due to again a priori preferences for geocentricity and for the circle over the ellipse.

The somewhat dismal picture conveyed by these remarks is not intended to suggest that phonology be abolished as a discipline (notwithstanding an Oregon court ruling of some years back to the effect that since the mouth is part of the alimentary canal, it is obviously not intended by nature for anything other than the consumption of food). It is, however, desirable that, insofar as they are neither dealing with relatively concrete and empirically definable phenomena nor merely writing 'hocus-pocus' grammars, phonologists should clearly acknowledge how far their speculations are, and perhaps must inevitably remain, removed from scientific adequacy. Under such conditions it is indispensable that the logical structure of a hypothesis be fully explored, and it is this, and no more, that we have attempted to do for boundaries in the first section of this paper.

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[17] In point of fact, one frequently encounters a curious philosophy of science. One's antagonist must be held to a fairly strong form of verificationism: he is guilty of "assumptions" which are "unsubstantiated", and his hypotheses are to be rejected because they have

Anderson, S.R. 1974. "On the typology of phonological rules." *Papers from the Parasession on Natural Phonology,* edd. A. Brock et al., 285-96. Chicago Linguistic Society.

Anderson, S.R. 1975. "On the interaction of phonological rules of various types." *Journal of Linguistics* 11.39-62.

Bierwisch, M. 1966. "Regeln für die Intonation deutscher Sätze". *Studia Grammatica* 7.99-201.

Brame, M.K. 1974 "The cycle in phonology: stress in Palestinian, Maltese, and Spanish". *Linguistic Inquiry* 5.39-60.

Brasington, R.W.P. 1970. "The treatment of exceptions in phonology". *Lingua* 29.101-19.

Chafe, W.L. 1959. "Internal reconstruction in Seneca". *Language* 35.477-95.

Chomsky, N. et al. 1956. "On accent and juncture in English". *For Roman Jakobson,* edd. M. Halle et al., 65-80. The Hague.

Chomsky, N. and M. Halle. 1968 [SPE]. *The Sound Pattern of English.* New York.

Coats, H.S. 1970. "Rule environment features in phonology". *Papers in Linguistics* 2.110-40.

Devine, A.M. and L.D. Stephens. 1974. "Phonological rules and structural constraints". *Papers in Linguistics* 7.51-68.

Duhem, P. 1906. *La théorie physique: son objet et sa structure.* Paris.

Greenberg, J.H. 1970. "On the 'language of observation' in linguistics". *Working Papers on Language Universals* (Stanford University) 4.G1-G15.

Harris, Z. 1951. *Methods in Structural Linguistics.* Chicago.

Hill, A. 1954. "Juncture and syllable division in Latin". *Language* 30.439-47.

Hill, A. 1958. *Introduction to Linguistic Structures.* New York.

Hoard, J.E. 1972. "Naturalness conditons in phonology, with particular reference to English vowels". *Contributions to Generative Phonology,* ed. M.K. Brame, 123-54. Austin.

Hoard, J.E. 1973. "On incorporating Grassmann's Law into Sanskrit phonology". Paper presented at the Western Conference on Linguistics, October 1973.

Hockett, C.F. 1949. "Two fundamental problems in phonemics". *Studies in Linguistics* 7.29-51.

Hockett, C.F. 1955. *A Manual of Phonology.* Memoir 11 *International Journal of American Linguistics.* Baltimore.

Hooper, J. 1973. *Aspects of Natural Generative Phonology.* Ph.D. diss.: University of California, Los Angeles.

Hooper, J. 1974. "Rule morphologization in natural generative phonology". *Papers from the Parasession on Natural Phonology,* edd. A. Brock et al., 160-70. Chicago Linguistic Society.

Hooper, J. 1975. "The archi-segment in natural generative phonology". *Language* 51.536-60.

Hyman, L.M. 1975. *Phonology: Theory and Analysis.* New York.

Juilland, A. 1961. *Outline of a General Theory of Structural Relations.* The Hague.

Kim, C.-W. 1970. "Boundary phenomena in Korean". *Papers in Linguistics* 2.21-26.

not been "established"; the protagonist, on the other hand, exhibits all the Popperian virtues: he formulates powerful theories rich in empirical content, and they are highly corroborated (it is suggested) because they cannot be refuted by any known evidence.

Kisseberth, C.W. 1970. "The treatment of exceptions". *Papers in Linguistics* 2.44-58.

Kisseberth, C.W. and M.I. Abasheikh. 1974. "On the interaction of phonology and morphology". *Studies in the Linguistic Sciences* 4.139-47.

Koutsoudas, A. et al. 1974. "The application of phonological rules". *Language* 50.1-28.

Leben, W.R. and O.W. Robinson. 1975. "Upside-down phonology". Manuscript of paper delivered at 50th Annual Meeting of the Linguistic Society of America.

Lehiste, I. 1960. *An Acoustic-Phonetic Study of Internal Open Juncture.* Supplement to *Phonetica* 5. Basle.

McCawley, J.D. 1968. *The Phonological Component of a Grammar of Japanese.* The Hague.

Ohala, J. 1974. "Phonetic explanation in phonology". *Papers from the Parasession on Natural Phonology,* edd. A. Brock et al., 251-72. Chicago Linguistic Society.

Phelps, E. 1975. "Sanskrit diaspirates". *Linguistic Inquiry* 6.447-64.

Pike, K. 1952. "More on grammatical prerequisites". *Word* 8.106-121.

Popper, K. 1969. *Conjectures and Refutations.* New York.

Postal, P.M. 1968. *Aspects of Phonological Theory.* New York.

Pyle, C. 1972. "On eliminating BM's". *Papers from the Eighth Regional Meeting of the Chicago Linguistic Society,* 516-32.

Quine, W. 1953. *From a Logical Point of View.* New York.

Rhodes, R.A. 1974. "Non-phonetic environments in natural phonology". *Papers from the Parasession on Natural Phonology,* edd. A. Brock et al., 285-96. Chicago Linguistic Society.

Sag, I. 1974. "The Grassmann's Law ordering pseudo-paradox". *Linguistic Inquiry* 5.591-607.

Saltarelli, M. 1970. *A Phonology of Italian in a Generative Grammar.* The Hague.

Schane, S.A. 1973. *Generative Phonology.* Englewood Cliffs.

Selkirk, E. 1974. "French liaison and the $\bar{X}$ notation". *Linguistic Inquiry* 5.573-90.

Shibatani, M. 1972. "The non-cyclic nature of Japanese accentuation". *Language* 48.584-95.

Sommerstein, A.H. 1973. *The Sound Pattern of Ancient Greek.* Publications of the Philological Society 23. Oxford.

Stanley, R. 1969. *The Phonology of the Navaho Verb.* Ph.D. diss.: Massachusetts Institute of Technology.

Stanley, R. 1973. "Boundaries in Phonology". *A Festschrift for Morris Halle,* edd. S.R. Anderson and P. Kiparsky, 185-206. New York.

Trager, G.L. 1962. "Some thoughts on juncture". *Studies in Linguistics* 16.11-22.

Trager, G.L. 1972. *Language and Languages.* San Francisco.

Trubetzkoy, N.S. 1969. *Grundzüge der Phonologie* (1939) transl. C.A.M. Baltaxe. Berkeley, Los Angeles.

Vachek, J. 1964. "Notes on the phonematic value of the modern English [ŋ] sound". *In Honour of Daniel Jones,* edd. D. Abercrombie et al., 191-215. London.

Vennemann, T. 1974. "Words and syllables in natural generative grammar". *Papers from the Parasession on Natural Phonology,* edd. A. Brock et al., 346-74. Chicago Linguistic Society.

Wells, R. 1947. "Immediate Constituents". *Language* 23.81-117.

Morphologization of Phonological Processes (Are there distinct morphonological processes?)*

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CONTENTS: 1. Introduction. 2. First hypothesis: phonological processes vs. paradigm regularity. 3.1. Second hypothesis: unidimensional two-way or three-way distinction. 3.2. Phonological vs. morphonological vs. morphological rules. 3.3. Literature. 3.4.1. Rule ordering. 3.4.2. Phonological plausibility. 3.4.3. Productivity. 3.4.4. Opacity. 3.4.5. Morphological conditions. 4.1. Rule split. 4.2. Morphologization vs. lexicalization. 5. Brief outline of a third hypothesis.

1. J. Greenberg has shown, several times (e.g. Greenberg 1969), the importance of diachronic studies for problems of general theoretical interest. In this vein I will try to discuss the question whether linguists should posit a special morpho(pho)nological (sub)component of grammar. This question has popped up again and again since Henryk Ułaszyn has invented the term 'Morphophonem',[1] A. Martinet maybe being the most outspoken detractor of morphonology.

For morphonology in the structuralist tradition I want to refer to Matthews (1974:77ff., 196ff.) and Haslev (1972), as I restrict my discussion to process morphonology. Even here there are many feasible approaches, amply discussed by Matthews (1972), e.g. in the slavicists' tradition such as Issatschenko (1975), Andersen (1969), or in the model of Mel'čuk (e.g. 1972), where morphonemic rules form a part of surface morphology.

For lack of space I will concentrate on one series of approaches only: postclassical generative phonology and related trends. My main reasons are 1) that here it seems to be most obvious how much of an understanding of morphonological phenomena linguists have reached or not,[2] and 2) that my own approach is much influenced by Stampean Natural Phonology.[3]

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[1] Already back in 1927 in *Prace Filologiczne* 12.406, a place usually not recognized by historians of linguistics.

It has been acknowledged more and more that early and classical generative phonology has relied too heavily on morphonemic alternations,[4] has failed to establish a morphological (sub?)component, and has incorrectly treated phonological, morphonological and morphological phenomena with the same rule format and with the same phonological criteria.[5] In the following I will discuss or at least outline three types of hypotheses to change this situation.

2. One rather simple type of hypothesis has been to postulate two opposing forces: phonological processes (described by rules) and paradigm regularity:[6] paradigm coherence is supposed to be a (the?) main characteristic of morphology, its result being in diachrony "that allomorphy within a paradigm tends to be minimized" (Kiparsky 1972:207).

But morphology typically contains highly complex structures of a non-phonological nature: cp. the intricacies of Hausa noun plural formation, the complex noun declension in East Caucasian languages such as Tabasaran and Bats, or even the rich nominal and verbal morphology of Sanskrit. In this case where language prehistory has been well reconstructed, one can trace back most of its morphological complexities to the morphologization of phonological and syntactic processes, but this makes things worse, since the allegedly regularizing influence of morphology has enlarged morphological complexity in this and other cases. Cp. also Hale's by now famous Maori example (Kiparsky 1971:590ff., cp. Schindler 1974:1).

So it seems that we have to acknowledge that in morphology irregularity too has a purpose of its own, which Anttila (1975) calls indexical, i.e. allomorphic differences have the semiotic function to signal (symbolize) different morphological functions or combinations of functions and to increase redundancy (cp. Anttila 1974:§2.3).

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[2] The negative, unsuccessful aspect is stressed by authors such as Anttila (e.g. 1974) and Linell (1974).

[3] For the theoretical bases of my stand see the book *Prinzipien der Prozess-Phonologie*, jointly elaborated by G. Drachman and W. Dressler.

[4] See still Zwicky (1975:154, 156).

[5] One or more of these failures are mentioned e.g. in many contributions to *Nat. Phon.*.

[6] E.g. Kiparsky 1971:596ff., 1972:206ff.; less enthusiastic 1974a).

3.1. A second type of hypothesis could be illustrated by the following graph:

	1	2	3	4
rules:	phonetic	phonological	morphonological	morphological

i.e. a scale is postulated, with 2 or 3 or 4 thresholds which are either clearly separated or not. They form distinct components, or phonetics is a subcomponent of phonology, and morphonology a subcomponent of either phonology or morphology. In diachrony, processes move up and down this scale, either gradually or discretely (by reanalysis of the speakers).

In the following discussion I will stick to four components, as it is the most differentiated form of the hypothesis and as I have believed in it myself for some time (Dressler 1976a, b, c). I will present a few examples for each rule type (§3.2), cite some relevant recent literature (§3.3), discuss defining (synchronic and diachronic) characteristics of components 2,3, and 4 (§3.4-5). Then I will add the mechanism of rule split (§4.1) and discuss morphologization vs. lexicalization (§4.2).

3.2. Phonetic processes, which I do not treat here, and which roughly correspond to detail phonetic, 'automatic' processes of generative phonology, could be exemplified by the slight palatalization of [k] adjacent to palatal vowels, e.g. in English and German.

Phonological processes (roughly corresponding to Stampe's Natural Processes), hereafter dubbed PRs, can be exemplified by entirely productive and phonetically plausible processes such as final devoicing of obstruents in German (rather Auslautverhärtung), Russian, Polish, Albanian and Breton dialects etc., or assimilation processes in many languages including allophonic processes such as aspiration of English voiceless stops or German[7]

$$\text{ç} \rightarrow \text{x} \,/\, \begin{array}{l}\text{Vowel}\\ [-\text{palatal}]\end{array}\_\_\_\_$$

Morphological processes (hereafter dubbed MRs) "account for various kinds of grammatically defined semantic distinctions" and are phonetically arbitrary having phonemes (or phonological input segments) as output (Skousen 1973b). Some examples: English umlaut, e.g. in *foot* - *feet*;[8] most contemporary German umlaut (Wurzel 1970:105ff.), e.g. in plural formation such as *Vater* 'father' – pl. *Väter* [ˈfɛːtəʳ], or in conjugation [iç ˈfraːgə̟] 'I ask' – [ziː ˈfrɛːkt] 'she asks', [ˈhatə̟] '(I) had' – [ˈhɛtə̟] 'would have'; ablaut in the verbal systems of English, German (Wurzel 1970:17f., 63ff.), Albanian (Dressler 1976b:§4), etc.; plural harmonic vowel laxing in Granada Spanish (Hooper 1974:164-7); reduplication processes (Wilbur 1973a, b, 1974); echo word formation (Mayerthaler 1975) such as in *singsong*; contemporary Celtic initial mutations.

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[7] I will defend elsewhere this direction of this PR (instead of $x \rightarrow ç$), cp. [ˈçi:na] 'China', [ˈfraoçən] *Frau* +*chen* 'woman' (diminutive: the PR holds only morpheme internally), [Iç] 'I', [ax] 'alas', [dUrç] 'through', [ˈmanç(ə)] 'some', [ˈzOlç] 'such'.

[8] A PR $u \rightarrow i$ is only possible in the vicinity of delabializing and palatalizing environments.

Morphonological processes (hereafter dubbed MPhRs) mix characteristics of PRs and MRs: they have morphological functions, but can still be described as (at least partially) phonologically plausible rules. Here we can cite palatalizations of the type[9]

$$\begin{array}{ll} & k \rightarrow \check{c} \\ \text{or} & \\ & k \rightarrow c \end{array} \Big/ \begin{array}{c} \text{vowel} \\ \_\_\_\_[+\text{palatal}] \end{array} \Big/ \begin{bmatrix} \text{certain} \\ \text{morphological} \\ \text{categories} \end{bmatrix}$$

in contemporary Romanic and Slavic languages and dialects; Bevington's [10] Albanian rule (1974:157)

$$u \rightarrow i \Big/ \begin{bmatrix} \alpha\ \text{syllabic} \\ \alpha\ \text{back} \\ -\text{low} \end{bmatrix} + \_\_\_\_$$

3.3. The distinction between PRs, MPhRs, and MRs can be compared with the following two-way or three-way distinctions in the literature (selected):

In Matthews (1972, 1974) MRs correspond to his morpholexical rule system, MPhRs to his morphophonemic rules (though they include all neutralization and sandhi processes regardless of their degree of phonologicalness), his phonology contains less than our PRs. Other concepts of direct structuralist origin are weak suppletion (≈ MPhRs), limited to alternations in one phonological segment only, and strong suppletion (≈ MRs), referring to whole morphemes (cp. Mayerthaler 1975:74ff.).

In generative grammar we compare to a certain extent the concepts of major rules (≈ PRs), minor rules (≈ MPhRs), and suppletion (≈ MRs), though their boundaries are ill-defined (Hudson 1974). Karlsson (1974) groups, with useful definitions, MPhRs rather with MRs than with PRs, even more rigorously Linell (1974:74ff.).[11] Anderson (1974a,b) differentiates morpholexical rules (= MRs, part of MPhRs),

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[9] Cp. Issatschenko (1975). Abstract non-palatal underlying segments for non-palatalizing palatal vowels (Anderson and Browne 1973) are not needed because of a MPhR.

[10] 1974:59-62, 67, 81, 108f., 114, 127; but cp. Dressler (1976b:§3).

[11] These and other authors speak of morphophonemic alternations instead of MPhRs. But this difference is most of the time a question of technical format, notational preferences, abstractness of the input, and lexicon model. Alternations between a basic and a secondary alternant can be translated into a unidirectional rule, others into bidirectional rules and vice versa. Processes or rules have the advantage of presenting the "dynamic nature of synchronic interpretations" (Issatschenko 1975:351).

PRs (= MPhRs, most of PRs) and phonetic rules.

In T. Vennemann's Natural Generative Phonology only PRs and MPhRs seem to be distinguished consistently,[12] with an allowance for separate (derivational) via-rules. Klausenburger (1975a) has a four-way distinction: PRs, semi-morphological rules (≈ MPhRs), MRs (inflectional), via-rules (derivational), whereas Klausenburger (1975b) calls MPhRs "hybrids combinating both phonological and morphological characteristics". Skousen (1973a, b) distinguishes PRs and MRs (including MPhRs), similarly Wilbur (1974).

In Stampean Natural Phonology there is the difference between natural, live processes (PRs) and learned, dead rules (MPhRs, MRs).[13]

3.4. Hypotheses of a one-dimensional distinction of PRs, (MPhRs) and MRs can only be accepted, if it is possible to find significant non-conflicting criteria for distinguishing rule types. The only larger set of such criteria I have found in the literature is Cearley's (1974) distinction of MRs and PRs, but most of his (purely synchronic) criteria are wrong and put forward without any evidence.

3.4.1. A very formal criterion advanced in the literature is synchronic rule ordering. In a two-way distinction all MRs (or MPhRs) should be ordered before all PRs.[14] But there are beautiful Javanese counter-examples in Dudas (1974) where a PR precedes three MRs, cp. deviating orders of MRs, MPhRs, and PRs in Anderson (1974a:xv, 1974b, 1975).[15] Another example: in Rumanian, according to St. Clair (1973:20) the MR of *ur*-insertion is ordered among MPhRs.

So one basic argument for distinguishing two or three different blocks of rules or components is eliminated.

3.4.2. The best argument for a three-way distinction is, in my opinion, the issue of phonological or phonetic plausibility of synchronic processes: PRs must be totally plausible, MRs implausible, MPhRs should lie in between. This criterion of plausibility can be divided into several subcriteria. First three rather formal ones:

3.4.2.1. The structural change (A → B) must involve a plausible quantum (in a plausible direction) in PRs, but may be an implausible one in MRs: cp. the ablauts *i* → *u*, *i* → *a*, *i* → ʌ in German and/or English and the English umlaut *u* → *i*. There are not even diachronic, context free phonological changes of this type (cp. Dressler 1971:341-3); cp. the implausible Irish initial mutations (lenitions) $d \rightarrow \gamma\ /\ \#\_\_\_$, $t \rightarrow h\ /\ \#\_\_\_$ (Armstrong 1975), synchronic derivational and inflectional rhotacism in Classical Latin $r \rightarrow s$ (see §4.1.1).

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[12] Cp Vennemann (1972); Hooper (1973, 1974, 1975:544ff.). Cp. Schane 1974.

[13] For the interpretation of this crucial difference see Rhodes (1974) and Bjarkman (1975); cp. Drachman (1973:166, 169), Lovins (1973).

[14] Vennemann (1971:125), Drachman (1973:166), Wilbur (1973b:686, 1974:393), Cearley (1974), Mayerthaler (1975). Cp. Dinnsen and Koutsoudas (1975) within their theory of intrinsic ordering.

[15] There is no reason why MRs, MPhRs and PRs should fare differently in the question of extrinsic vs. intrinsic ordering, since extrinsic ordering statements for MRs can as easily (and often ad hoc) be reformulated to intrinsic formulations.

Conversely MRs, MPhRs, and PRs may substitute segments with input segments (phonemes), but only PRs and MPhRs (depending on their definition) may substitute segments with allophones (cp. Schane 1974, Cearley 1974).

3.4.2.2. Then there must be a phonetically plausible (conditioning or favoring) environment in PRs, but not in MRs: e.g. rhotacism in Classical Latin (see §4.1.1)

$$\mathrm{r} \rightarrow \mathrm{s}\ /\ \_\_\_\mathrm{t} \text{ (in certain categories)}$$

makes no phonetic sense.

MRs usually are context free (in regard to phonological contexts, see §3.4.2.1), e.g. plural and appertentive formation in Luo (Anderson and Browne 1973:458) such as *got* 'mountain', *lwedo* 'hand', pl. *gode, lwete*, app. *god, lwet*: context free voicing or devoicing occurs in diachronic change (e.g. Grimm's law), at least in diachronic correspondences as results of change, but apparently not in synchronic, generative PRs (the prohibition of absolute neutralization being a consequence).

3.4.2.3. How do MPhRs fare in respect to the two criteria of §3.4.2.1f.? Not all of them are plausible in respect to structural change (§3.4.2.1). When Latin rhotacism was still an MPhR of the form $s \rightarrow r\ /\ \mathrm{V}\_\_\_\mathrm{V}$ voicing between vowels is plausible, but the quantal leap $s \rightarrow r$ is too big (cp. Zwicky 1975:155f.); the same holds for Italian and Slavic palatalization MPhRs: $k \rightarrow \check{c}$ before palatal vowel is fine, but the quantal leap seems too big: notice that phonological palatalization in Russian involves the much smaller quantum $k \rightarrow k'$ (e.g. *apteka* 'pharmacy', *v apte*[k']*e* 'in the pharmacy'). Cp. the synchronic chain of lectal variants in Quechua (Cerrón-Palomino 1974:48): k - k^y - t^y - $\check{c}$. These variants correspond fairly well to reconstructed intermediary steps in the change Latin k > Italian $\check{c}$.

Thus the diachronic origin of such eccessive quantal leaps is clear: rule telescoping:[16] e.g. in Cheremis the unvoiced stops had the following parallel developments (also beyond boundaries, see Rédei 1974):

$$\mathrm{p} > \mathrm{b}\ /\ \begin{Bmatrix}\mathrm{N}\\ \mathrm{V}\end{Bmatrix}\ \_\_\_\mathrm{V} \quad \text{later} \quad \mathrm{b} > \mathrm{w}\ /\ \mathrm{V}\_\_\_\mathrm{V}$$

Due to morpheme internal restructuring, synchronic alternations between *p* and *w* were restricted to sandhi phenomena, where both rules were abbreviated to the single sandhi rule

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[16] W. Wang, *Language* 45 (1969), 23 note 23; Hooper (1973:206ff.); Mayerthaler (1975), etc.

$$\text{p} \rightarrow \text{w} \,/\, \text{V}\_\_\_\_\# \text{ V}$$

e.g. /iδa pu/ 'don't give' gives [iδa wu]. Whereas this telescoped rule seems to have exceptions, the remaining, non-telescoped rule

$$\text{p} \rightarrow \text{b} \,/\, \text{m}\_\_\_\_\# \text{ V}$$

seems not to have.

Cp. Latin rhotacism

$$\begin{array}{l} \text{s} \rightarrow \text{z} \,/\, \text{V}\_\_\_\_\text{V} \\ \text{z} \rightarrow \text{r} \,/\, \text{V}\_\_\_\_\text{V} \end{array} > \text{s} \rightarrow \text{r} \,/\, \text{V}\_\_\_\_\text{V}$$

Or in Greek *s* > *h* > Ø was telescoped to *s* → Ø and inversed to Ø → *s* in different contexts, with the result of phonetically unnatural alternations *s* ~ Ø (Greenberg 1969:173).

A PR does not seem to be able to survive telescoping, which can be explained by G. Drachman's Quantal Hypothesis.

On the other hand a phonologically unnatural quantal leap does not imply an implausible phonological context or vice versa: e.g. Italian palatalization may involve an excessive leap *k* → *č* and be morphologically and lexically conditioned,[17] but there is still the plausible phonological environment 'before palatal vowels'. Old Italian texts show some fluctuation (Rohlfs 1968:II.44ff., III), which subsists even today to some extent in derivations, e.g. *greco* 'Greek', pl. *greci*, but *grecizzare* (with [č]) = *grechizzare* (with [k]) 'to hellenize'. But compare the following derivations: *grecità, grecismo, grecista, grechesco, grecheggiare* (other examples in Wanner 1972). As far as I can see, there is a strong tendency to have [k] = <ch> before /e/ and more [č] before /i/ than before /e/, i.e. the phonological hierarchy

$$\text{palatalization} \quad \text{———} \begin{bmatrix} -\text{consonant} \\ \text{higher !} \end{bmatrix}$$

is respected, as even morphonological palatalization is better preserved before high /i/ than before mid /e/. A parallel has been found by my student J. Hufgard for Sanskrit palatalization.

3.4.2.4. Another diachronic origin of phonological implausibility is the mechanism of rule inversion (Vennemann 1972, 1974; Hudson 1974).

The direction of the MR of Latin rhotacism (§4.1.1) *r* → *s* is simply unnatural, much more than the excessive quantal leap of the preceding MPhR *s* → *r* / V____V. Here rule inversion might be a main factor in the change of an MPhR into an MR. But also MRs can be inverted, e.g. Germ (Rück-)umlaut (Robinson 1975:25f.): MHG *troeste* 'I comfort' – pret. *trôste* > NHG *tröste*, pret. *tröste-te*.

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[17] E.g. *amico* 'friend', pl. *amici* with [č], *duca* 'duke', pl. *duchi* with [k], see Matthews (1974:209f.), Wanner (1972).

Inverted MPhRs may remain MPhRs, e.g. diphthongization of stressed vowels in the verb paradigms of Spanish is inverted to monophthongization of unstressed diphthongs in Spanish (Norman-Sanders 1975), and of diphthongs before vowels in the Albanian aorist and nominal paradigms (Dressler 1976b:§6), e.g. *punua-m* 'we worked' – *puno-i* 'he worked', *krua* 'source' – *kro-i* 'the source'. Monophthongization of unstressed diphthongs or of diphthongs before another tautosyllabic vowel is phonologically plausible.

But also inverted PRs may remain PRs; e.g. German *x* → *ç* (except after palatal vowels, morpheme initially, and after consonants) >

$$\text{ç} \rightarrow \text{x} \,/\, \underset{[-\text{pal}]}{\text{V}}\underline{\qquad}$$

(cp. §3.2). Here the inversion results in a more predictable and circumscribed environment and in the derivation of the less frequent from the more frequent alternant (cp. these principles in Vennemann 1974:139). The inversion has involved the interchange of plausible directions and environments. A similar case can be found in Magnus' (1973) treatment of Aramaic syncope and epenthesis.[18]

If these examples are correct, then rule inversion is possible for all mentalized processes: MRs, MPhRs, and PRs (consequently not for phonetic processes), because these processes, if they have a psychological reality, express the direction of alternations from a primary to a secondary alternant.

Another problem for the distinction of PRs, MPhRs, and MRs is the observation that phonetic plausibility is a matter of degree (Matthews 1972:378f.).

3.4.3. Another, related fundamental criterion that is expected to neatly distinguish 'live processes' and 'dead rules', is said to be productivity. This term has several meanings:

3.4.3.1. First it may mean exceptionlessness (cp. Cearley 1974:30, 32): if PRs are considered to be normally exceptionless (e.g. Hudson 1974), so are many (regular) MRs; and if vowel harmony rules applying to suffixes only are said to be MPhRs, since they are phonologically plausible, but have a morphological function, then they are often exceptionless. And as even PRs can have (morphologically conditioned) exceptions (cp. Campbell 1971:199f., Wilbur 1973a, b), synchronic exceptionlessness is not a qualitative criterion.

Diachronic changes in the amount of exceptions do not help much either: exceptions decrease in PRs, as shown abundantly by protagonists of lexical diffusion such as W. Wang, M. Chen, H. Hsieh etc.; but lexical diffusion is also attested in MRs[19] and in MPhRs: e.g. the palatalization in Italian *colgo, cogli* ([ˈkol'i]) 'I, you pick' is inverted to velarization and extended to forms like *valgo, vali* 'be valuable'.[20]

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[18] Maybe also Scott (1975:146). J. Kuryłowicz has often dealt with the interchange of terme fondé and terme de fondation.

Increase of exceptions or lexical fading is well known from MRs (e.g. Celtic mutations §4.2.1, cp. O'Bryan 1973) and MPhRs (by way of analogy, e.g. Kiparsky 1974b:265). For PRs it depends on how one defines them: Finnish gradation (with increasing exceptions) remains a PR for Kiparsky (1971:632f.), but (justly) not for Lovins (1973) and Anttila (1975b:91f.).

So should we say that a PR, because of its basic productiveness, is incompatible with increasing exceptions (and even more with rule loss, if it comes about by lexical fading)?[21]

3.4.3.2. A second meaning of productivity is applicability of a process to new forms, e.g. neologisms, cp. already decrease of exceptions in §3.4.3.1. This criterion must be fulfilled by PRs (cp. Anttila 1975b), at least in the theories of Natural Phonology and Natural Generative Phonology, by phonological Surface Structure Constraints, and wherever PRs are said to be absolute constraints on the pronounceability of utterances.

There are, of course, many productive MRs, but also unproductive ones, as Steinberg and Krohn (1973) have shown experimentally for English derivations such as *maze, mazic, mazity*. MPhRs often are thought to be inherently unproductive. This is not true e.g. for Italian palatalization (§3.4.2.3): if one forms a new polysyllabic adjective in *-ico-*, its plural must be *-ici* ([iči] masculine), e.g. *lapsologico* 'pertaining to the study of errors'; cp. Churma's (1974) experiments for the productivity of Turkish vowel harmony with neologisms.

Thus also productivity in this sense is a very weak criterion.

3.4.3.3. A third sense of productivity is applicability of a rule in the assimilation of loan words: PRs are applied (cp. Lovins 1973, Anttila 1975b), but in different degrees (Holden 1974), and so are productive MPhRs such as Turkish vowel harmony in suffixes (Zimmer 1967:170) and productive (both inflectional and derivational) MRs.[22]

Natural processes may even apply, if they have no chance to apply in indigenous words: e.g. Yoruba has no final stops. But there are Yoruba speakers who in speaking English regularly devoice final voiced stops.

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[19] Strong verbs in Icelandic, Swedish (Linell 1972:10) and German, plural umlaut in German (Haslev 1972:120, Russ 1975:60), . Scott (1975:147).

[20] Rohlfs (1968:II.259-61); Wanner (1972:§2 (35), §3).

[21] For other ways of rule loss cp. e.g. Schindler (1974:4-7).

[22] Scott (1975:147) or Celtic mutations. There is abundant literature on this subject in historical linguistics (e.g. Gusmani 1973:25ff.), so Cearley's (1974:32) opposing speculations are puzzling in this regard as well.

For lack of space and of representative studies about all three rule types I do not go into other external evidence (cp. Zwicky 1975). So far the criterion of productivity has not differentiated between PRs, MPhRs, and MRs.[23]

3.4.4. Opacity[24] seems to be a good candidate, as all PRs seem to be transparent and at least all MPhRs opaque (Cearley 1974, Hooper 1975 note 14). However MRs may be morphologically either transparent or opaque (cp. O'Bryan 1973, Skousen 1973b, Klausenburger 1975a), normally they are phonologically opaque, because PRs normally apply after MRs. If a MR is crucially ordered after a PR (e.g. Dudas 1974), then the PR becomes opaque, though it still remains a productive, natural PR. MPhRs are phonologically opaque, but usually they are morphologically transparent (as they usually apply after MRs).

Therefore opacity is, if at all, only a derived criterion; its value for diachronic phonology is questionable (cp. Schindler 1974).

3.4.5. Final good candidates for differentiating rule types seem to be morphological restrictions. E.g. adherents of Natural Generative Phonology claim that true PRs have no morphological restrictions whatsoever, as the morpheme plays no role in phonological generalizations.[25]

3.4.5.1. The most important aspect of morphological restrictions is the condition that PRs must not be restricted to operate only in certain morphological categories, whereas MPhRs and MRs must. This condition is incorrect.

For lexical diffusion there is an interesting case in Gaelic (Jackson 1968): *ē* is broken (by a diphthongizing PR) to *ia, eu* etc. (according to the dialect), first in the ordinal number *a ˈchiad* 'the first', then in the cardinal numbers *diag* 'teen', *sia* 'six', then in various lexical items; the last item to undergo the rule is the proper name *Siamas* 'James'.

In Albanian (cp. Dressler 1976b:§2) the centralization PR

$$\text{i} \rightarrow \text{ë} \; / \; \underset{[-\text{stress}]}{\underline{\qquad}}$$

is restricted in formal styles to certain suffixes, e.g. *kisha* 'I had' – admirative of 'to work' *punó-kësha*. But in casual styles we find this PR generalized, e.g. in *lërohem* 'I liberate myself' instead of *lirohem*.

In a very formal style of a Breton dialect (Dressler 1972:47ff.) the centralization

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[23] Cearley's claim (1974:31f.) about spoonerisms originating only between MRs and PRs is blatantly wrong, as inspection of any relevant literature shows.

[24] Kiparsky (1971, 1974a), Schindler (1974) etc., corresponding to earlier surface ambiguity.

[25] E.g. Hooper (1973 (criticized by Cerrón 1974:71 note 4), 1975); cp. Karlsson (1974:32). For further critique cp. Y.-Ch. Morin, *Recherches linguistiques à Montréal* 5 (1975), 175-182.

$$\text{e} \rightarrow \text{ə} \: / \: \underset{[-\text{stress}]}{\underline{\qquad}}$$

is restricted to two inflectional suffixes, whereas the more casual the style becomes, the more mid (and, finally, non-high) vowels are centralized, with phonological AND morphological, syntactic and semantic conditions regulating successive generalizations. Other cases of morphological restrictions applying only in formal styles for the same PRs and of PRs which diachronically start in certain morphological categories, can easily be found in the literature (e.g. Kiparsky 1972:199ff., Linell 1974:99, Cerrón 1974:65f.).

As it is absurd to posit different competences for different (non-dialectal, non-diglossic) styles of the same language, it would be equally absurd to claim that the same process is a MPhR in formal styles, but a PR in casual styles. Therefore PRs can be written with diacritic or morphological markings, which deprives us of another formal difference between PRs and MPhRs plus MRs.

But maybe diachronic increase of morphological restrictions is incompatible with the status of a PR.

3.4.5.2. Another characteristic of PRs is – according to Natural Generative Phonology – the total insignificance of morpheme boundaries, as opposed to MPhRs (and MRs).

However there is abundant counterevidence, e.g. the German PR (§3.2)

$$\text{ç} \rightarrow \text{x} \: / \: \overset{\text{V}}{[-\text{palatal}]} \underline{\qquad}$$

holds only within morpheme boundaries, but it holds across syllable boundaries and applies after the umlaut MR, e.g. [ˈla.x+ən] ‘to smile’, diminutive [ˈlɛ.ç+əln]. In Dressler (1976a) I have assembled 7 (10) PRs which apply only morpheme internally, and 6 PRs which apply in formal styles only morpheme internally, but in casual styles also across morpheme boundaries (for other examples see Cerrón 1974:43f., 66, 69; Rhodes 1974; Timberlake 1974).

3.4.5.3. On the other hand certain abstract rule schemata may be posited for MRs (and MPhRs ?), but not for PRs, e.g. (phonologically) context free exchange rules occur in morphology (Anderson and Browne 1973), but not among synchronic or diachronic PRs (cp. Dressler 1971:341).

3.5. Conclusion: the second hypothesis fares badly under close scrutiny: formal criteria such as rule ordering (§3.4.1), opacity (§3.4.4), and rule inversion (§3.4.2.4) may show a certain quantitative, non-discrete distinction; phonetic plausibility (including the inability to survive rule telescoping) distinguish PRs from (nearly?) all MRs and many MPhRs (§3.4.2.1-3).

As to productivity, only diachronic increase of lexical exceptions (§3.4.3.1), of morphological restrictions (§3.4.5.1) and the status of exchange rules (§3.4.5.3) seem to be incompatible with PRs.

Thus we have not found a single criterion for MPhRs that is independent from criteria for PRs or MRs; border lines between rule types are floating, nor does it seem to be possible to assign all MPhRs or a well-defined sub-set thereof to MRs or PRs. §4 will show other aspects of diachronic morphologization which call for another hypothesis (§5).

4.1. One phenomenon connected with morphologization of PRs is rule split.

4.1.1. In this respect even the well-known example of Latin rhotacism has been much simplified. Authors have concentrated on rule telescoping (see §3.4.2.3) and rule inversion (see §3.4.1.4). Rule inversion from *s* → *r* to *r* → *s* and (prior, as I believe) morphologization have been assumed in the nominal inflection of *hónōs* 'honor', gen. *honṓris* (with *r* in all other cases than the nominative) etc., since only in this way paradigmatic leveling to nom. *honor* could be explained in this type, as well as in *árbor* 'tree', gen. *árboris*, comparative *máior* 'bigger' (masc., fem.), gen. *māiṓris, múlier* 'wife', gen. *mulíeris* etc. Leveling has occurred[26] in case of maximum phonetic similarity (*mā́iōs* > *mā́ior*, but the neuter *mā́ius* remained despite of gen. *māiṓris* etc., cp. *genus* 'gender', gen. *generis, cinis* 'ash', gen. *cineris*), helped by the parallelism of words in original *-ṓr*, *-ṓris* and by infrequency (*Lar* 'one of the group of *Lares*' against other monosyllables; neuters with *-s* in nom. = acc. sg.).

Have these been constraints on paradigmatic leveling only or already on rule inversion? I.e. is *genus* derived from *generis* etc. by

MR (2) r → s / _____# / nom. sg. of X classes

or *generis* from *genus* by

MPhR or MR (1′) s → r / V_____+ V / X classes?

Here the criterion of type and token frequency speaks for the first solution, the criterion of basic category for the second one.[27]

Decisive evidence comes from diminutive formation: the diminutive morpheme *-culus* (m.), *-cula* (f.), *-culum* (n.) is attached to the stem (sometimes a thematic vowel intervenes), and not to the nominative: e.g. nom. *auri-s* 'ear', dim. *auri-cula* (not **auris-cula*), *dens* 'tooth' (underlying /dent+s/), dim. *dent-i-culus* (not **densculus*). Now the diminutive of *mulier* (< **mulies*) is *mulier-cula*, but from *pulvis* 'dust', gen. *pulver-is* (< **pulvis-is*) it is *pulvis-culus*, from *mas* 'man', gen. *mar-is* it is *mas-culus*, cp. *corpus-culum, opus-culum, mūs-culus, flōs-culus* etc.

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[26] See especially Schindler (1974:2-4), Klausenburger (1975a, b), Mayerthaler (1975).

[27] Cp. Vennemann (1974:139), Robinson (1975:26f.). There is a problem of diverging leveling in Scott (1975).

Therefore the stem and the underlying form of nouns with *-s* in the nominative and *-r* in the other cases still has final *-s*, and the rule (1′) is still operative. (It would be also unusual to apply first an inflectional MR changing *r* to *s* and only then to apply a rule of word formation). Thus rule inversion has only taken place in those classes where paradigmatic leveling of *s* to *r* has followed.[28] This makes us suspicious of other instances where rule inversion has been postulated without clear evidence.

We have seen that from MPhR (1′) has split up the inverted MR (2), which has then been lost by paradigmatic leveling. But a cognate MR (2′) which has split up from (2) subsists

MR (2′) $r \rightarrow s \,/\, \_\_\_\_\_ + \left\{\begin{matrix} s \\ t \end{matrix}\right\}$ / Y morph. categories

in *ger-o* 'I lead', perfect *ges-s-i*, past participle *ges-tus*, with the frequentatives *ges-to, ges-tito* and the agent noun *ges-tor* derived from the stem of the participle, cp. *ur-o* 'I burn', *haer-e-o* 'I adhere' etc. The arguments for rule inversion are here the higher frequency of *r*-forms and the basic character of present in regard to perfect and participle.

In derivational morphology both directions subsist: MPhR (1′) is found in the rare compounds *dir-imo* 'I take apart', *dir-ibeo* 'I keep apart' etc. from the preverb *dis-* or in *nefās* 'sacrilege', adj. *nefār-ius* 'sacrilegious' or in *foedus*, gen. *foeder-is* 'treaty', *foeder-āti* 'allies'. MR (2′) is found in *arbor* 'tree', adj. *arbus-tus, honor*, adj. *hones-tus, heri* 'yesterday', adj. *hes-ternus*. *Nefās, foedus, arbor, honor, heri* are basic from the semantic point of view, and from a derivational one, since there are no synchronic back-derivations in Latin which reduce the shape of words.

4.1.2. In Old Armenian a much more complicated rule split has occurred which can be summarized as follows (cp. Dressler 1976c:§5). For prehistoric Armenian I reconstruct a PR of vibrant weakening

(1) $\dot{r} \rightarrow r \,/\, \_\_\_\_\_$ except n, s

which weakened the vibrant *ṙ* to a tap (*r*) except before homorganic nasal or fricative. This PR has split up in the following ways: there subsists an optional PR

(2) $\dot{r} \rightarrow r \,/\, V\_\_\_\_\_V$

in *eṙeak* = *ereak* 'trinity'. Then there is a partially optional, partially lexicalized MPhR in echo-word formations

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[28] *Arbus-cula*, diminutive of *arbor* (older *arbōs*) has been preserved, presumably because of the phonological difference in the vowel (due to sound change). Later levelings have come about word for word, not by morphological classes, e.g. *vomis* > *vomer*, gen. *vomer-is* 'plough', *pulvis* > *pulver*.

(3) ṙ → r / ____+ / reduplicative syllables

in e.g. *bar-baṙ* 'language', *mr-mṙ+em* = *mṙ-mṙ+em* 'I grumble'. Finally there is an inverted MPhR

(4) r → ṙ / ____n (within word boundaries)

in e.g. *duṙn* 'door', gen. *dran, ayr* 'man', gen. *aṙn*, but with intervening word boundary *ayr#n* 'the man', *yaṙ-n+em* 'I rise', aorist *yar-eay*.

MPhR (4) still works in loan-words such as *poṙnik* 'whore', though there are many exceptions to it in inherited words: but they never occur in words where *ṙn* does not alternate with *ṙVn* (thus it is a productive redundancy rule). Exceptions are only due to paradigmatic leveling. There are a few exceptions which can be explained by the direction of the inverted MPhR (4) e.g. *garun* 'spring', gen. *garn-an*, but there are many, e.g. *beṙn* 'load', gen. *beṙin*, which can be explained by lexical fading or a non-inverted MPhR

(1′) ṙ → r / ____ except n

before rule inversion to (4).

This multiple rule split seems to be due to the interaction of various sound changes (e.g. *s* > *h* > Ø / ____V, sonorant) and subsequent restructurings which rendered rule (1) an opaque, implausible, crazy rule.[29]

4.1.3. Another instance of rule split in Old Armenian (cp. Dressler 1976c:§4) would be the development of the prehistoric PR

(1) h → Ø / segment____

into the Old Armenian lexicalized and optional MPhR[30]

(2) h → Ø / #____

in e.g. *(h)ogi* 'spirit', and into a lexicalized MPhR in nominal compounds

(3) h → Ø / C +____V / certain verbal roots

in e.g. *jeṙn-at* 'one's hand cut off' to *hat-anem* 'I cut', and into a rather productive MPhR in echo-word formation

(4) $h \rightarrow \emptyset / h\ V_i\ C_j + \_\_\_\_ V_i C_j$

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[29] Cp. Bach and Harms (1972). Thus rule telescoping (§3.4.2.3) can be regarded as a part of the outcome of abbreviated rule interactions: due to restructuring, the input of the first rule of a rule series can be connected directly with the output of the last rule of the same series in the case of allomorphic alternation. This abbreviatory mechanism could be called rule conflation.

[30] Or already inverted to optional (2′) Ø → *h* / # ____ as in Middle Armenian?

in e.g. *hot-ot-im* 'I smell', *hag-ag* 'breath', and into an MPhR applying after monophonemic verbal prefixes

$$(5)\qquad h \rightarrow \emptyset \;/\; \#\; C + \underline{\qquad} V$$

in e.g. *z-at-anem* 'I cut' or *č'-awat-am* 'I do not believe' to *hawat-am* 'I believe'.

4.1.4. For Grassmann's law in Ancient Greek a similar rule split can be postulated.[31] The reconstructed PR

$$(1)\qquad [+\text{obstr}] \rightarrow [-\text{aspirated}] \;/\; (+)\underline{\qquad} C_0\ V\ C_0\ (+)\ [+\text{asp}]$$

first has been extended to apply to *h*[32] and *hr* (< *s*, *i̯* and *sr* respectively) as well, and provoked a by-rule (MPhR)

$$(2)\qquad [+\text{coronal}] \rightarrow [-\text{asp}] \;/\; \begin{bmatrix}+\text{cor}\\ +\text{asp}\end{bmatrix} V + \underset{[\text{imperative}]}{\underline{\qquad}}$$

e.g. in [ˈtutʰēti] 'be sacrificed!' from /tʰu+tʰē+ti/. Then it split into a rather productive PR[33]

$$(3)\qquad [+\ \text{cons}] \rightarrow [-\text{asp}] \;/\; \underline{\qquad} C_0\ V\ C_0\ (+) \begin{bmatrix}+\ \text{asp}\\ \text{stem}\end{bmatrix}$$

e.g. in *tí-tʰē-mi* 'I put', lexicalized in *amp-ékʰō* 'I surround' (← *ampʰí* 'around'), but generalized in more casual documents, e.g. in names such as *Eképʰulos* instead of *Ekʰé-pʰulos*).[34] Moreover it split up into a lexicalized MPhR, restricted to stems with initial dental.

$$(4)\qquad [+\text{cor}] \rightarrow [-\text{asp}] \;/\; +\underline{\qquad} V + \begin{bmatrix}+\text{cor}\\ +\text{asp}\end{bmatrix}$$

e.g. in *tú-tʰē-ti*, and into an exceptionless stem-internal MPhR (stems beginning and ending with different obstruents)

$$(5)\qquad [+\text{cor}] \rightarrow [-\text{asp}] \;/\; +\underline{\qquad}(r)\ V \begin{bmatrix}-\text{cor}\\ +\text{asp}\end{bmatrix}$$

e.g. in *trikʰ-ós*, gen. of *tʰrík-s* 'hair' (underlying /tʰrik +s/), *trépʰ-ō* 'I nourish', fut. *tʰrép-s-ō*[35]. MPhRs (4) and (5) show crazy environments due to lexical fading, which occurred according to (arbitrary) phonological categories; obviously some frequent sound gestalts resisted lexical fading better.

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[31] See Dressler (1975). Miller (1974) has a split-up into two rules only, also in his larger study (Miller 1977).

[32] Many authors have neglected that at a later stage *h*-dissimilation has been restricted (lexicalized) to a single verb with initial *h* : *ékʰ-ō* 'I have'.

[33] Totally productive only with the morphological function to signal reduplication or echo-word formation.

[34] This generalization might well reflect an older stage than more recent restrictions in formal styles.

[35] Or rule inversion, i.e. aspirate throw-back (cp. Miller 1974), which would be a remarkable MPhR, having the semantically basic form as underlying in the present, but as derived in the nominative.

4.2. In order to endorse my view that neither bipolar opposition between phonological naturalness and morphological paradigm regularity (§2) nor a unidimensional scaling of phonological and morphological characteristics (§3) allows sufficient explanations of morphologization (or rather 'dephonologization') of PRs, I add very short remarks on lexicalization vs. morphologization.

4.2.1. Often lexical (plus related word semantic) conditionings or restrictions of PRs and MRs are not kept apart in synchronic and diachronic investigations. Karlsson (1974:43f.) correctly speaks of morphologization of PRs, if they symbolize, in the process of degeneralization, a grammatical function, and of lexicalization, if they do not.

In lexical diffusion and generalization of casual pronunciations of certain lexical items (§.4.5.1) there is a direct decrease in the degree of lexicalization of a PR, without morphological categories necessarily playing a role. However there is no direct diachronic lexicalization of a PR. There seems to be a general sequence, first morphologization, then lexicalization.

A good example is Celtic initial mutations: first they were productive PRs applying everywhere within phrase boundaries. Then, due to restructuring, they were restricted to apply over morpheme and word boundaries only. Because of the loss of grammatical morphemes, word or morpheme initial mutations acquired important morphological functions and were more and more restricted to apply in and be triggered off by certain morphological categories. Telescoping, more complicated rule conflation (§.1.3), rule split, opacity were concomitants and factors of increasing phonological implausibility. Only when initial mutations were solidly morphologized, i.e. had become MRs or nearly, so it seems, did lexicalization occur: here I do not mean the fact that they are provoked by arbitrary sets of e.g. prepositions and conjugations, but that only certain words (to be marked in the lexicon) undergo certain mutations. Ternes (1970:142ff.) has documented this for Breton: he postulates a rule split of the historically original 4 rules into 11 rules, and even then subparts of these rules behave differently as to lexical exceptions.

However in a stratified lexicon (cp. Lovins 1973) increasing or decreasing lexicalization is a possible change, according to the (re)assignment of words to different lexical strata. E.g. in Turkish for a long time vowel harmony has not applied to stems, especially not to loans. Violations of vowel harmony became even a sign of foreignness. Thus in assimilating loans a sort of anti-vowel-harmony could apply, such as in vowel epenthesis breaking up non-permitted consonant clusters, cp. Ger. *Schwester* 'nurse' which became *şɪvester* with central [ɨ] instead of front [i] in violation of front vowel harmony, cp. the much earlier Persian loan *birader* 'brother' with a front instead of a central high vowel.

Lexical diffusion processes of PRs being a different matter (§3.4.5.1), one can venture the hypothesis (cp. Hooper 1973:§12, 1974:167) that MRs and MPhRs may never become PRs. To my knowledge this hypothesis is inductively valid as much as the related hypothesis I want to propose: syntactic processes may be morphologized, but not vice versa. But syntactic processes may be both lexicalized (via morphology) and start with arbitrary (?) lexical items, a parallel to lexical diffusion and fading in phonology.

4.2.2. As to derivational morphology, lexicalists claim that it is part of the lexicon. Similarly adherents of Natural Generative Phonology claim that PRs morphologized in derivational morphology become so-called via-rules which relate individual lexical items among themselves (Vennemann 1972:224ff.).

These via-rules seem to represent word associations of very different kinds, which must be distinguished. Moreover also in derivational morphology degrees of productivity must be noted: though there is much more lexicalization than in inflectional morphology, there exists also morphologization comparable to inflectional morphology (cp. §4.1.1-3).

Adherents of Natural Generative Phonology have claimed at times[36] that via-rules are bidirectional,[37] i.e. that it is equally easy or difficult to predict each of two related words from one another. But in productive or semi-productive derivations the principles of basic semantic and morphological category, of frequency and predictability (conditioning environments) usually reveal one of the words as basic with respect to another related one. E.g in Latin rhotacism (§4.1.1) there is a clear unidirectional relation between *nefas* and *nefar-ius*, *heri* and *hes-ternus*. Should claims about bidirectionality simply ignore the work done in derivational morphology for over one century?

5. Lest I end with a negative note, I will very briefly outline a third hypothesis about morphologization which I will treat elsewhere in detail.[38]

5.1. Phonology and morphology are qualitatively different dimensions, lexicon is a third dimension. All three components have quite different character, therefore exigencies of optimal phonology, morphology, and lexicon are in conflict.

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[36] Hooper (1973:§§2.3, 4), Hudson (1974), not yet Vennemann (1972).

[37] Not in the sense of stratificational grammar or Mel'čuk (1972) where opposed directions are assigned to speaker and hearer.

[38] Inter alia in a projected book on word formation, for which this contribution represents a sort of preparatory work. Of course my hypothesis has many precursors already in the 19th century (cp. Anttila 1974, 1975a).

Although all three components operate with the same phonological input segments (Postal's naturalness condition), sound-meaning relations are guaranteed by morphology and lexicon only: in both components phonological operations are quite different from PRs, e.g. morphemes have gestalt qualities (cp. language disturbances) and are susceptible to sound symbolism.

5.2. Optimal phonology basically means maximal productive application of PRs, according to the language specific basis of articulation.

Optimal morphology means e.g. paradigmatic transparency (1 meaning ≡ 1 form) and syntagmatic transparency (optimal perception of morpheme and word boundaries), productivity of MRs which symbolize syntactic and semantic functions. Paradigmatic transparency is furthered either by agglutination or by having special cues for specific combinations of functions.

Optimal lexicon means inter alia individualization of denotative and connotative meaning of single words and word fields in order to optimally express the communicative needs of groups and individuals, including idiosyncratic symbolic marking of words. Semantic associations between words should be marked by morphological and phonological means, in the first case by derivational morphology, in the second case by specific phonological characteristics.

PRs and MRs fulfill the optimal exigencies of their components in different degrees, i.e. one can establish scales or squishes.

5.3. There are no MPhRs, but simply PRs which have also some function in the morphological component, i.e. they are PRs and MRs at the same time. It is important to note that a greater degree of phonological generality of a PR does not automatically imply its smaller amount of morphological functioning. One typical diachronic change of a PR would go from a productive, lexically diffusing PR without any morphological function to a still more productive and general PR with a subsidiary morphological function (e.g. of redundantly signalizing case distinctions). A next stage would be a phonologically rather unproductive PR, which would be at the same time a productive MR. In a final stage this MR would cease to function as a PR.

The reverse way, I suppose, does not occur: perceptual requirements (e.g. guarantees of morpheme analysis for the hearer, according to speech situation and style etc.) may restrict the application of rules, restrictions being either phonological or morphological or both. Morphological function and clarification is more important than phonological plausibility, in accordance with the communicative and symbolic function of language. E.g. morphological clarification seems to be an important cause of rule inversion, rule telescoping, and rule conflation, as in these ways a direct and morphologically transparent link is established between morphological alternants.

5.4. Saying that many input-output-relations are expressed by PRs and MRs at the same time, violates the economy principle of generative grammar, that significant generalizations should be expressed only once in a grammar. But it does not matter in a model which strives for psychological reality, since it reflects multiple storage in the brain and redundancy.

5.5. The third dimension is the lexicon. Due to its individualizing function — cp. the principle of each word having a history of its own — there is a tendency to mark words with positive or negative rule features (both in regard to MRs and

PRs); this tendency (i.e. lexicalization) is easier accomplished in derivational than in inflectional morphology, whereas paradigmatic leveling is easier and more systematic in inflectional morphology.

5.6. Rule split occurs, when a PR is restricted to symbolizing highly divergent morphological functions. The resulting (split) PRs may conspire to a certain degree (phonologically and often unproductively), but they are neither a single process nor can they become one.

5.7. In order to illustrate, at least briefly, my hypothesis, I want to characterize some of the processes discussed in §3.4 according to their simultaneous functions as PRs and MRs:

The German assimilation process *ç* → *x* (§§3.2, 3.4.5.2) is a fully productive and plausible PR, its inverted form is a rare concomitant of morphological umlaut, with the weak morphological role of redundantly co-signalling various functions of umlaut. There is no remarkable change in this respect to earlier stages of German.

The Breton weakening process of unstressed *e* → *ə* (§3.4.5.1) is a plausible and productive PR, though exceptionless only in very casual and rapid speech styles; there it applies also to integrated loan words.[39] The slower and the more formal the style becomes, the more phonological, syntactic, semantic, and morphological constraints apply, in order to guarantee better perception of morphological elements. And in the most formal style only two morphemes undergo the process; thus only there the PR has also a definite, unequivocal morphological function, i.e. of signalling two homophonous inflectional suffixes, e.g. [ˈdøːət] 'come' (past participle) from /døː+et/. It is not possible to posit an underlying /ət/, as forms like [laˈkeːt] 'put' (past participle) can be derived only from /laka+et/, not from */laka+ət/. Therefore the PR is also a non-opaque MR in formal style only. Presumably earlier Breton had formal styles without this weakening (cp. also the 'double plural' *-éd-où* of some dialects); younger speakers tend to generalize weakening (trend to monostylism = restriction to casual speech in language decay).

Old Armenian $r \rightarrow \dot{r}\ /\ \underline{\quad}\ n$ (MPhR 4, §4.1.2) is a rather productive PR (in spite of its opacity) with a weak (and morphologically opaque) morphological function, but it is a not very plausible PR: why should a tap be lengthened to a vibrant before (and only before) [n]? In Modern (West) Armenian, due to leveling and sound change, the alternation *r* – *ṙ* is only preserved in very few petrified (lexicalized) forms such as *daṙnal* 'to turn', aorist *darjay*; *r* is always retained before the suffixes *-ner* (plural), *-nal* (infinitive), *-nis* ('our').

On the other hand $\dot{r} \rightarrow r\ /\ \underline{\quad}+\ /$ reduplicative syllable (MPhR 3) is more plausible (i.e. weakening in a copied syllable), but the whole copying is a MR — reduplication is even one of the few universal MRs with distinct phonic properties of its own, one of them being weakening of the sound-shape of the reduplicative syllable. But in Old Armenian this PR is, at best, semi-productive, and it is highly lexicalized. It is even questionable whether it is a PR at all, or rather a MR with phonic consequences (such as German *ç* → *x* which is a PR with consequences in morphological shapes).

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[39] The treatment of loan-words in very casual speech styles is a, so far, unexplored criterion: it seems that only fully integrated loan-words can undergo all radical casual speech processes that apply to native words, even if there might be no difference between fully and less integrated loan-words in formal styles.

Uninverted Latin rhotacism (MPhR1) $s \rightarrow r \,/\, \mathrm{V}\underline{\quad}+\mathrm{V}$ (§4.1.1) is an exceptionless PR (before the degemination *ss* > *s* took place), since no *s*-stems have a genitive in *-s+is* or verb form in *-s*+V (*dis-unire* 'to disunite' is Late Latin only); but notice that the application of the rule depends crucially on the correct position of the morpheme boundary (cp. *rosa* 'rose', *dē+sino* 'I end'), and that the quantal leap is implausible. The productivity of the PR depends entirely on the productivity of the respective MRs and morphological categories (stem classes). Since in the Romance languages Latin nominatives have died out as well as the neuter gender, no nominal *s*-forms survived; on the other hand the prefix *dis-* has ousted its rare byform *dir-*.

The inverted form (MR 2,2′) $r \rightarrow s$ (§§3.4.2.2, 4.1.1) has been morphologically and phonologically unproductive, phonetically implausible, and highly lexicalized. It lexicalized completely later on.

In Albanian we have a phonologically plausible, but unproductive PR (§3.2), which falls into 4 parts and corresponds to and depends on two productive MRs (which follow the MRs of inserting the underlying segments *i* and *u* respectively):

(1)

$$\mathrm{i} \rightarrow \mathrm{u} \,\Big/ \left\{ \begin{matrix} \begin{bmatrix} \mathrm{C} \\ +\mathrm{back} \end{bmatrix} \\ \begin{bmatrix} \mathrm{V} \\ -\mathrm{back} \\ -\mathrm{round} \end{bmatrix} \end{matrix} \right\} + \underset{\substack{\text{postponed} \\ \text{article}}}{\underline{\qquad\qquad\qquad}}$$

thus combining assimilation after consonants and dissimilation after vowels, e.g. *beg* 'bey', *beg-u* 'the bey', *shi, shi-u* 'rain'. In some dialects this rule has been lost, thus *beg-i*; no dialect has generalized *-u*.

(2)

$$\mathrm{i} \rightarrow \mathrm{u} \,\Big/ \left\{ \begin{matrix} \begin{bmatrix} \mathrm{V} \\ +\mathrm{back} \\ +\mathrm{round} \end{bmatrix} \\ \begin{bmatrix} \mathrm{C} \\ -\mathrm{back} \end{bmatrix} \end{matrix} \right\} + \underset{\text{[3.sg. aorist]}}{\underline{\qquad\qquad\qquad}}$$

i.e. combining a dissimilation after vowels with a rather implausible assimilation after consonants, e.g. *hap-i* 'he opened', *shkro-i* 'he wrote' (but *fry-u* 'blew'). Here /u/ must be the underlying form, as the reflexive (passive) *u hap* is best explained as being dissimilated from /u hap+u/ (Bevington 1974:81). Some dialects have generalized *-u* after vowels, thus *shkro-u*; no dialect has generalized *-i*.

Interestingly, the origin of these MRs are not PRs that later morphologized; according to Domi (1967:19, 59-62) *-ki, -gi* were replaced by *-ku, -gu*, in order not to be changed by palatalization PRs to *-kj, -gj*, i.e. in order to preserve a clearly perceivable morpheme; -V*i* gave -V*u* possibly due to an intermediate glide (?), obviously also no regular PR.

The Italian palatalization (§§3.4.2.4, 3.4.3.2)

$$\mathrm{k} \rightarrow \check{\mathrm{c}} \,/\, \underline{\qquad\quad} + \left\{ \begin{matrix} \mathrm{i} \\ \mathrm{e} \end{matrix} \right\}$$

is an unproductive PR with a plausible environment, but an implausible quantal leap. Its degree of applicability depends entirely on the productivity of the different MRs to which it is attached; of these only the plural formation of polysyllabic adjectives in *-ico*, pl. *i*[č]*i* is productive. Thus palatalization cosignals highly divergent morphological functions, which allows the prediction of rule split (§5.6). And this has already happened in the Lucchese dialect, provided that (lexically limited) rule inversion is thought to precede or accompany analogical leveling of the type *leggo, leggi* "I, you read' [ˈlego, ˈleǰi] > *leggio* [ˈleǰo], *leggi* (Rohlfs 1968:II.258). Rule split and partial rule inversion due to functional divergence accounts for the Albanian development (see above).

For Celtic initial mutations (§3.4.2.1, 4.2.1) I take the example of Breton (cp. Dressler 1972a): there are several MRs that are invoked by arbitrary morphological categories and morphemes and that are partially lexicalized (cp. Ternes 1970:142ff.). The main types are I. provection transforming initial *g, b, d* into *k, t, p*, II. spirantization transforming initial *k, t, p* into [h], *z*, *f*, and III. lenition with the transformations of initial *k, t, p* > *g, d, b, g, (gw), d, b, m* > [h], *(w), z, v, v*. II has the highest morphological and lexical incidence, I the smallest.

One could argue that these mutations aren't PRs at all, since they are (phonologically) completely unproductive, phonologically context-free, and are entirely triggered and constrained by morphological and syntactic categories. However 1) these mutations are 'unphonological' in varying degrees: I and IIIa make some phonological sense, as they change the value of a single distinctive feature in a possible direction and in the same systematic way for all underlying segments (even in the case of 'new' provection and lenition which unvoice or voice spirants in some dialects), which is not the case in II and IIIb.

2) that I and IIIa go together, comes to light in language decay (Dressler 1972a:450-2): though lenition (with the highest type and token frequency) is best preserved, it is not provection (with the lowest one) which is first to go in the decaying Breton of young native speakers. In reality the first mutation lost is II (spirantization), then IIIb ('irregular' lenition, with complex 'lexical fading' going on); I and IIIa are best preserved and have a common fate, although IIIa fares better due to its higher frequency. The reason for the better persistence of I and IIIa seems to be their greater phonological plausibility, which could be expressed by a very simple α-switching rule. If one argues that it is rather the simpler connection between the input and the output of the two MRs, then also this simplicity would have to be described in phonological terms.

Thus these MRs seem to have marginal, unproductive and (rather) implausible PRs attached to them. One can give similar arguments for German, English, Albanian etc. ablaut and German umlaut (§3.2); notice also the pseudophonological environment of some ablaut classes such as ..../____N in German and English *schwimmen-schwamm-geschwommen* = *swim-swam-swum*, *singen-sang-gesungen* = *sing-sang-sung*, *sinken-sank-gesunken* = *sink-sank-sunk*. Thus various combinations of PRs and MRs are possible. So far, only processes functioning as general and fully productive PRs and MRs at the same time, seem to be excluded.

5.8. The relation between phonology and morphology and therefore the mechanisms of morphologization are much more complex than current structuralist, stratal, and generative theories would make us believe. And there seems to lurk the danger in current trends of renascent morphological studies that simplistic hypotheses (e.g. of classical generative grammar) are replaced by even simpler and less refined ones. Simple and elegant generalizations about problems which refer to several components of grammar seem to be possible only at a rather superficial level: either hypotheses are one-sided and neglect relevant data (particularly of less well-known languages than English) or they express quantitative generalizations about and relations between two (or very few) phenomena at a time, as J. Greenberg's pioneering studies have shown.

Andersen, H. 1969. "A study in diachronic morphophonemics". *Language* 45.807-30.

Anderson, S.R. 1974a. *The Organization of Phonology.* New York.

Anderson, S.R. 1974b. "On the typology of phonological rules". *Nat. Phon.* 1-12.

Anderson, S.R. 1975. "On the interaction of phonological rules of various types". *Journal of Linguistics* 11.39-62.

Anderson, S.R. and W. Browne. 1973. "On keeping exchange rules in Czech". *Papers in Linguistics* 6.445-82.

Anttila, R. 1974. *Analogy.* University of Helsinki, Department of Linguistics, Dress Rehearsals 1.

Anttila, R. 1975a. *The Indexical Element in Morphology.* Innsbrucker Beiträge zur Sprachwissenschaft, Vorträge 12.

Anttila, R. 1975b. "Exception as regularity in phonology". *Phon.* 91-9.

Armstrong, J. 1975. "A note on initial mutation in Modern Irish". *Linguistic Inquiry* 6.317-23.

Bach, E. and R.T. Harms. 1972. "How do languages get crazy rules?". *Linguistic Change and Generative Theory*, edd. R.P. Stockwell and R.S. Macaulay, 1-21. Bloomington.

Bevington, G. 1974. *Albanian Phonology.* Wiesbaden.

Bjarkman, P.C. 1975. "Toward a proper conception of processes in natural phonology". *Papers from the Eleventh Regional Meeting of the Chicago Linguistic Society*, 60-72.

Campbell, L. 1971. Review of R.D. King, *Historical Linguistics and Generative Grammar*, *Language* 47.191-209.

Cearley, A. 1974. "The only phonological rule ordering principle". *Nat. Phon.* 30-42.

Cerrón-Palomino, R. 1974. "Morphologically conditioned changes in Wanka-Quechua". *Studies in the Linguistic Sciences* (University of Illinois) 4,2.40-75.

Churma, D.G. 1974. "Vowel harmony in Turkish". *Linguistic Society of America Meeting Handbook* 49.24 (cited after the manuscript).

Dinnsen, D.A. and A. Koutsoudas. 1975. "On the explanation of rule ordering". *Linguistic Society of America, Fiftieth Annual Meeting Handbook*, 31.

Domi, M. 1967. *Morfologjia Historike e Shqipes.* Tirana.

Drachman, G. 1973. "On the interpretation of phonological primes". *Working Papers in Linguistics* (Ohio State University) 15.161-73.

Dressler, W. 1971. "Some constraints on phonological change". *Papers from the Seventh Regional Meeting of the Chicago Linguistic Society*, 340-9.

Dressler, W. 1972. *Allegroregeln rechtfertigen Lentoregeln.* Innsbrucker Beiträge zur Sprachwissenschaft 9, Innsbruck. (A shortened French version is "Essai sur la stylistique phonologique du Breton". *Etudes Celtiques* 14 (1974).99-120.

Dressler, W. 1972a. "On the phonology of language death". *Papers from the Eighth Regional Meeting of the Chicago Linguistic Society*, 448-57.

Dressler, W. 1975. "Zur Rekonstruktion phonologischer Prozesse im Altgriechischen: Grassmanns Gesetz". *Bereiche der Slavistik*, Festschrift Hamm 53-67. Vienna.

Dressler, W. 1976a. "Begrenzen Morphemfugen die Domäne phonologischer Prozesse?". *Festschrift Issatschenko*, edd. N. Salnikov and H. Pohl. Klagenfurt.

Dressler, W. 1976b. "Phonologische, morphonologische und morphologische Regeln des Albanischen". *Innsbrucker Albanologische Tagung*, ed. H. Ölberg. Innsbruck.

Dressler, W. 1976c. "Das Altarmenische und die Phonologietheorie". *Festschrift Mechitar* (special volume of Handes Amsorya), ed. M. Topalian. Vienna.

Dudas, K. 1974. "A case of functional phonological opacity: Javanese elative formation". *Studies in the Linguistic Sciences* (University of Illinois) 4,2.91-111.

Greenberg, J.H. 1969. "Some methods of dynamic comparison in linguistics". *Substance and Structure of Language*, ed. J. Puhvel, 147-203. Berkeley and Los Angeles.

Gusmani, R. 1973. *Aspetti del prestito linguistico.* Naples.

Haslev, M. 1972. *Morfo-fonemik.* Oslo.

Holden, K.T. 1974. "Assimilation rates of borrowing and phonological productivity". Indiana University Linguistics Club.

Hooper, J.B. 1973. *Aspects of Natural Generative Phonology.* Ph.D. diss.: University of California, Los Angeles.

Hooper, J.B. 1974. "Rule morphologization in natural generative phonology". *Nat. Phon.* 160-170.

Hooper, J.B. 1975. "The archi-segment in natural generative phonology". *Language* 51.536-560.

Hudson, G. 1974. "The representation of non-productive alternation". *Historical Linguistics* II, edd. J. Anderson and C. Jones, 203-229. Amsterdam.

Issatschenko, A. 1975. "Morphonologische Motivierung phonologischer Merkmale". *Phon.* 335-352.

Jackson, K.H. 1968. "The breaking of original long $\bar{e}$ in Scottish Gaelic". *Celtic Studies A Matheson*, edd. J. Carney and D. Greene, 65-71. London.

Karlsson, F. 1974. *Phonology, Morphology, and Morphophonemics.* Gothenburg Papers in Theoretical Linguistics 23.

Kiparsky, P. 1971. "Historical Linguistics". *A Survey of Linguistic Science*, ed. W. Dingwall, 576-649. University of Maryland.

Kiparsky, P. 1972. "Explanations in phonology". *Goals of Linguistic Theory*, ed. S. Peters, 189-227. Englewood Cliffs.

Kiparsky, P. 1974a. "On the evaluation measure". *Nat. Phon.* 328-37.

Kiparsky, P. 1974b. "Remarks on analogical change". *Historical Linguistics* II, edd. J. Anderson and C. Jones, 257-75. Amsterdam.

Klausenburger, J. 1975a. "(De-)morphologization in Latin". Manuscript, cp. *Linguistic Society of America, Fiftieth Annual Meeting Handbook*, 88.

Klausenburger, J. 1975b. "Rhotacism in Latin: phonological or morphological rule?". (manuscript).

Linell, P. 1972. "Remarks on Swedish morphology". *Reports from Uppsala University Department of Linguistics* 1.

Linell, P. 1974. "Problems of psychological reality in generative phonology". ibid. 4.

Lovins, J.B. 1973. *Loanwords and the Phonological Structure of Japanese.* Ph.D. diss.: University of Chicago. (cp. "The phonological 'stratification' of the Japanese lexicon from a natural-generative point of view". *Descriptive and Applied Linguistics* 8 (1975).97-114).

Magnus, G.B. 1973. "A case of rule reversal?". *Papers from the Institute of Linguistics, University of Stockholm* 16.1-7.

Matthews, P.H. 1972. *Inflectional Morphology.* Cambridge.

Matthews, P.H. 1974. *Morphology.* Cambridge.

Mayerthaler, W. 1975. *Studien zur theoretischen und französischen Morphologie*. Diss.: University of Munich.

Mel'čuk, I.A. 1972. *Urovni predstavlenija vyskazyvanij i obščee stroenie modeli 'smysl ⟷ tekst'.* Moscow: Institut Russkogo Jazyka ANSSR, Vypusk 30.

Miller, G. 1974. "Some problems in formulating aspiration and deaspiration rules in Ancient Greek". *Glossa* 8.211-32.

Miller, G. 1977. "Was Grassmann's Law reordered in Greek?'. *Indogermanische Forschungen*.

Nat. Phon.: *Papers from the Parasession on Natural Phonology*, edd. A. Bruck et al. Chicago Linguistic Society, 1974.

Norman, L. and G. Sanders. 1975. "Vocalic variations in Spanish verbs". *Linguistic Society of America Meeting Handbook* 50.110.

O'Bryan, M. 1973. "Opacity and the loss of a morphological process". *Studies in the Linguistic Sciences* (University of Illinois) 3,1.102-120.

Phon.: *Phonologica 1972*, edd. W. Dressler and F. Mareš 1975. Munich.

Rédei, K. 1974. "Sandhi-Erscheinungen in den Permischen und Wolga-Finnischen Sprachen". *Acta Linguistica Academiae Scientiarum Hungaricae* 24.307-12.

Rhodes, R.A. 1974. "Non-phonetic environments in natural phonology". *Nat. Phon* 285-96.

Robinson, O.W. 1975. "Abstract phonology and the history of umlaut". *Lingua* 37.1-30.

Rohlfs, G. 1968. *Grammatica storica della lingua italiana e dei suo dialetti*. Turin.

Russ, C. 1975. "Umlaut in German: the development of a phonological rule". *York Papers in Linguistics* 5.51-65.

Schane, S.A. 1974. "How Abstract is Abstract?". *Nat. Phon.* 297-317.

Schindler, J. 1974. "Fragen zum paradigmatischen Ausgleich". *Sprache* 20.1-9.

Scott, J.R. 1975. "Morphological development in noun plurals of four Catalan dialects". *Texas Linguistic Forum* 2.142-51.

Skousen, R. 1973a. "On the nature of morphophonemic alternation". Indiana University Linguistics Club.

Skousen, R. 1973b. "On analogy". *Linguistic Society of America, Forty-eighth Annual Meeting Handbook*, 151-2 (cited after a manuscript 1974).

St. Clair, R.N. 1973. "The plural formation in Rumanian". *Linguistische Berichte* Papier 40.

Steinberg, D. and R. Krohn. 1973. "The productivity of vowel alternations in English derived forms". *Working Papers in Linguistics* (University of Hawaii) 5,6.24-47.

Ternes, E. 1970. *Grammaire structurale du breton de l'île de Groix*. Heidelberg.

Timberlake, A. 1974. "Morphemę boundaries in phonological change". *Linguistic Society of America, Forty-ninth Annual Meeting Meeting Handbook* (cited after a manuscript).

Vennemann, T. 1972. "Rule inversion". *Lingua* 29.209-242.

Vennemann, T. 1974. "Restructuring". *Lingua* 33.137-156.

Wanner, D. 1972. "The derivation of inflectional paradigms in Italian". *Generative Studies in Romance Languages*, edd. J. Casagrande and B. Saciuk, 293-318. Rowley.

Wilbur, R.B. 1973a. "The phonology of reduplication". Indiana University Linguistics Club.

Wilbur, R.B. 1973b. "Reduplication and rule ordering". *Papers from the Ninth Regional Meeting of the Chicago Linguistic Society*, 679-87.

Wilbur, R.B. 1974. "When is a phonological rule not a phonological rule?". *Nat. Phon.* 385-95.

Wurzel, W.U. 1970. *Studien zur deutschen Lautstruktur.* Studia Grammatica 8. Berlin.

Zimmer, K.E. 1967. "A note on vowel harmony". *International Journal of American Linguistics* 33.166-71.

Zwicky, A.M. 1975. "The strategy of generative phonology". *Phon.* 151-68.

Reconstructing Nasals in Proto-Benue-Kwa

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Introduction

Most recent discusssion of the classification of African languages has been in the framework of, or in reaction to, Greenberg's classification of 1963. The best way of confirming or modifying a classification is to attempt reconstruction. In this paper we bring together the results of independent reconstructions of the nasals in two subgroups of Greenberg's Kwa; subgroup e, here called the Ẹdo group (Elugbe 1973), and subgroup h, here called the Ịjọ group (Williamson, unpublished). Interesting discoveries there, particularly in the light of Hyman's (1972) hypothesis about nasals and nasalization in Kwa languages, led us to make further comparisons with another Kwa subgroup, Greenberg's subgroup g ('Ibo'), here called the Lower Niger group, and with a number of Benue-Congo subgroups. We conclude, first, that at least five nasals have to be reconstructed for their common ancestor, and second, that as Greenberg himself suggested (1963:39), there is no clear dividing line between Kwa and Benue-Congo.

1. Proto-Ẹdo

1.1. The consonants reconstructed for Proto-Ẹdo at the systematic phonetic level are shown in Table I.

The *h*-series represent a lenis series shorter in duration and less firm in articulation and, therefore, more likely to become fricatives and approximants in the daughter languages. Thus if one compares the reflexes from which a fortis sound is reconstructed with those from which a lenis sound is reconstructed, one finds that the fortis plosives tend to be retained as plosives while the lenis series tend to develop into implosives and approximants. Sometimes a zero reflex turns up. In a few cases fortis and lenis have merged. In Table II we give examples of typical reflexes for Proto-Ẹdo (PE) **d* and **dh*. The same relationship is observed between fortis *m, n* and lenis *mh, nh* respectively.

TABLE I: PROTO-ẸDO CONSONANTS

STOPS									
Implosive			ɓ		ɗ				
Plosive	Fortis	p	b	t	d	k	g	kp	gb
	Lenis	ph	bh	th	dh	kh	kph	gbh	
Affricate			ts	dz					
NASALS									
Fortis			m		n				
Lenis			mh		nh				
FRICATIVES		f	v	s	s'				
APPROXIMANTS									
Lateral						l			
Central							y*		w

*IPA [j]

TABLE II
TYPICAL DEVELOPMENT OF PE FORTIS AND LENIS ALVEOLAR PLOSIVES

PE	*Engenni*	*Ẹdo (Bini)*	*Auchi*	*Ghotuọ*	*English*
də̃ĩ	dei	de	de	de	'fall'
do	do	do	do	do	'weave'
e-də	é-dè	?	ɛ́-dà	ɛ-dà	'river'
dhɪ	ɗɪ	ɹe	ḷe[1]	e	'eat'
a-dhʋ	à-ɗʋ̀	àɹò	à-ḷò	à-ò	'eyes'

---

[1] [ḷ] is a tapped alveolar lateral. The difference between [l] and [ḷ] is primarily in duration: [l] is of longer duration than [ḷ]. Note also the following conventions:

[ɓ] is a voiced bilabial implosive.
[ɗ] is a voiced alveolar implosive.
[ɹ] is a voiced alveolar central approximant. It is automatically nasalized in the environment of nasalized vowels.

Nasalization is not marked if it can be predicted from a neighbouring nasal; we mark nasalization where we feel this cannot be predicted from a preceding or following nasal. For example:

PE ii-s'ĩə̃nhi 'five' from postulated pre-Ẹdo	*-siŋənhi
PE ii-nhĩãnhɪ 'eight' from	*-nhɪŋanhɪ
but PE ɛ-nhamhɪ 'animal, meat' from	*-nhamhɪ

Tone marking in the Ẹdo examples is as follows: ´ for high; mid tone unmarked, ` for low and ! for downstepped high. Tone is not marked on verb-stems, since verbs have no inherent tones in the Ẹdo languages cited.

1.2. Another consonant, *s'*, is of a character that is at the moment unclear. Its reflexes include voiceless, breathy-voiced, and voiced sounds. Since *s* has been reconstructed so far in only two items while *s'* has been reconstructed in twelve items, it may well be that at a systematic phonemic level *s* and *s'* will be found to be complementary to each other. For example, on the basis of the reconstructions so far made, we find two cases with *s* in clearly oral roots and twelve cases with *s'* in roots where a nasal is either present or can be postulated to have been present. Although the evidence is not conclusive, the following postulated developments (if sustained by additional data) would suggest that *s* and *s'* can be linked via a nasality and breathy-voicing rule.

	Pre-Proto-Ẹdo	*Nasalization*	*Breathy-voicing*	*Proto-Ẹdo*
(1)	sV(CV)			/sV(CV)/
(2)	sVŋV	sṼṼ	s'ṼṼ	/s'VV/
(3)	sVŋVNV	sṼṼNṼ	s'ṼṼNṼ	/s'ṼṼNV/

Note in this case the preservation of nasalization because of a following nasal (cf. (2)).

(4)	sVNV	sṼNṼ	s'ṼNṼ	/s'VNV/

Note that (3) differs from (4) in that nasalization in (3) is significant and derives from a lost -ŋ- while the case of (4) involves only automatic nasalization in the environment of a nasal consonant.

(1)-(4) suggest that *s* became *s'* in the environment of phonetically nasalized vowels. Examples of these postulated developments are given below:

Pre-Proto-Ẹdo	*Nasalization*	*Breathy-voicing*	*Proto-Ẹdo*
/ɪɪ-sa/			/ɪɪ-sa/ 'three'
/ʊ-sɔŋʊ/	[-sɔ̃ʊ̃]	[-s'ɔ̃ʊ̃]	/ʊ-s'ɔʊ/ 'ear'
/ii-siŋənhi/	[-sĩ́ẽnhĩ́]	[-s'ĩ̀ẽnhĩ́]	/ii-s'ĩ̀ẽnhi/ 'five'
/samhɪ/	[sãmhĩ]	[s'ãmhĩ]	/s'amhɪ/ 'forget'

1.3. There are ten oral and eight nasalized vowels reconstructed for Proto-Ẹdo as shown in Table III.[2]

We conclude from the distribution of vowels in the reconstructions that Proto-Ẹdo operated vowel harmony of the Kwa type in which the vowels fall into two sets, one characterized by an expanded pharynx and the other by the absence of such expansion (cf. Lindau 1975; Stewart 1967). The two sets obtained by classifying Proto-Ẹdo vowels in terms of Lindau's feature are shown in Table IV. Only vowels from the same set can occur in the same root.

[2] Cf. Elugbe (1973) for an earlier, different view.

TABLE III: PROTO-ẸDO ORAL AND NASALIZED VOWELS

ORAL					NASALIZED				
i				u	ĩ				ũ
	ɪ		ʊ			ɪ̃		ʊ̃	
e				o					
ɛ				ɔ		ɛ̃		ɔ̃	
		ə					ə̃		
		a					ã		

TABLE IV
PROTO-ẸDO VOWELS ACCORDING TO
PHARYNX EXPANSION

Expanded pharynx			*Non-expanded pharynx*		
i		u	ɪ		ʊ
e		o	ɛ		ɔ
	ə			a	

1.4. Proto-Ẹdo roots are generally of the following shapes:

CV (including CṼ)
CV_1V_2 (including CṼṼ)
$C_1V_1C_2V_2$ (where C_2 is either *-dh-* or *-s'-*) and
CV_1NV_2 (where N is either *-mh-* or *-nh-*).

Thus only *dh, s', mh,* and *nh* can occur as non-initial root consonants. However, these consonants also occur in root-initial position. For example, *m, n* contrast with *mh, nh* respectively in root-initial position though no such contrast exists in -N- position.

1.5. In a number of cases where either *-mh-* or *-nh-* is reconstructable for Proto-Ẹdo, some of the daughter languages usually have Ṽ or ṼṼ. For example, Proto-Ẹdo **ɪ-nhɪ̃ãnhɪ* 'eight' results in Aoma *è-ɛ̃́ɛ̃̀*; Proto-Ẹdo **ʊ-khʊmhɪ* 'war' results in Ghotuọ *õ-h̃ɔ̃̀*. Compared with languages which retain these nasals in one form or the other, we find for 'eight' Ẹdo (Bini) *è-ɹɛ̃̀ɹɛ̃́* and Uhami *ì-níéní*; and for 'war' Uhami *ɛ́rɛ́-hùmù*.

1.6. We must now examine the cases where nasalization in the Ẹdo languages is not traceable to Proto-Ẹdo *-mh-* or *-nh-* and one has to reconstruct Ṽ or ṼṼ for Proto-Ẹdo. Two facts are of interest here: (1) the irregularity in having *-mh-* and *-nh-* but not *-ŋh-* or *-ŋ-* (henceforth simply *-ŋ-*), and (2) significant vowel nasalization which can arise from the loss of *-mh-* and *-nh-* (cf. the examples given above).

Taking these two facts into account, we may assume that Proto-Ẹdo CṼ and CṼṼ roots have come from roots which at an Early- or Pre-Proto-Ẹdo level had a nasal different from *-mh-* and *-nh-* and highly liable to be lost. *-ŋ-* is just such a nasal. We conclude, therefore, that *-mh-* and *-nh-* behaved differently from *-ŋ-* and that Proto-Ẹdo CṼ and CṼṼ roots have developed from Pre-Proto-Ẹdo *CVŋV.

1.7. There is interesting evidence in Dẹgẹma, Engenni (Ẹgẹnẹ) and Aoma to support this hypothesis.[3] In Dẹgẹma,

Proto-Ẹdo

CVmhV > CVm
CVnhV > CVn;

but in those cases where we would now postulate Pre-Proto-Ẹdo -ŋ-,

VCŋV > CṼṼ (if the second vowel is a high one)
> CVV (if the second vowel is *not* a high one).

In Engenni (Ẹgẹnẹ),

Proto-Ẹdo CVmhV > CVmV ~ CVm
CVnhV > CVnV ~ CVn; but
Pre-Proto-Ẹdo CVŋV > CṼṼ > CVV

In Aoma,

Proto-Ẹdo CVmhV > CVmV but
CVnhV > CṼṼ > CṼ
Pre-Proto-Ẹdo CVŋV > CṼṼ CṼ

Examples to support the Dẹgẹma, Engenni, and Aoma cases are summarized in Table V.

TABLE V
REFLEXES OF PRÓTO-ẸDO/PRE-PROTO-ẸDO *-N-*
IN DẸGẸMA, ENGENNI, AND AOMA

Pre-Proto-Ẹdo	*Proto-Ẹdo*	*Dẹgẹma*	*Engenni*	*Aoma*	*Gloss*
-nhamhɪ	ɛ-nhamhɪ	ɛ̀-nám	à-nàm(ʋ̀)	é-ã̀mì	'animal, meat'
khɔnhɪ	khɔnhɪ	kɔn	kɔn(ɪ)	khɔ̃ĩ	'fight (vb.)'
-thaŋɪ	ʋ-thãĩ	ʋ́-!tã́ĩ́	ɛ̀-tàɪ̀	ó-rã̀	'tree'
-kiŋə	-kĩɔ̃	ú-!kíé	í-kìè	έ-kɛ̃̀	'egg'

The case of Aoma is interesting because it shows a case in which both velar and alveolar -N- drop out, nasalizing the surrounding vowels, while the bilabial nasal is still retained: a process that started with *-ŋ-* has now been extended to *-nh-*. Presumably, the bilabial nasal will follow eventually.

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[3] Dẹgẹma and Engenni are Delta Ẹdo languages while Aoma is a North-Central Ẹdo language spoken by Iuleha clan of Ọwan Division.

2. Proto-Ịjọ

2.1. Proto-Ịjọ is reconstructed with the consonants shown in Table VI.

TABLE VI: CONSONANTS OF PROTO-ỊJỌ[4]

Obstruents				
voiceless				
non-stop	f	s		
stop	p	t	k	kp
voiced				
non-implosive	b	d	g	gb
implosive	ɓ	ɗ		
Sonorants				
non-nasal				
non-approximant		l	γ	
approximant	w	r	y*	
nasal	m	n	ŋ	

*IPA [j]

2.2. Proto-Ịjọ is assumed to have had a system of ten contrasting oral vowels with vowel harmony of the usual West African type, just as described for Proto-Ẹdo (see 1.3. above).

2.3. All modern varieties of Ịjọ have nasalized vowels save one (Ịbanị) which has clearly lost them quite recently. Following Hyman 1972, we postulate that Ịjọ CṼ results from CNV which in turn results from CVNV (cf. Williamsom 1973a). The main reason for assuming this is that it allows us to explain certain restrictions on the occurrence of nasalized vowels. Allowing P to stand for voiceless stops, B to stand for voiced stops, and F for fricatives and sonorants, we find:

(1) PṼ	(4a) *V-PṼ	(4b) *VN-PV
(2) BṼ	(5a) *V-BṼ	(5b) VN-BV
(3) FṼ	(6a) V-FṼ	(6b) *VN-FV

The distribution shown can easily be explained by postulating the following earlier forms:

---

[4] Ịjọ transcriptions are systematic-phonetic. Automatic nasalization resulting from an adjacent nasal is not marked.

(1) PNV
(2) BNV
(3) FNV
(4) V-PNV
(5) V-BNV
(6) V-FNV

and the following historical rules:

(1) Nasal Metathesis. N metathesizes with a preceding stop which is itself preceded by a vowel.
(2) Stop Voicing. P is voiced by a preceding N.
(3) Vowel Nasalization. CNV > CṼ.

These rules will apply as follows:

	Nasal metathesis	*Stop voicing*	*Vowel nasalization*
(1) PNV	-	-	PṼ
(2) BNV	-	-	BṼ
(3) FNV	-	-	FṼ
(4) V-PNV	VN-PV	VN-BV	-
(5) V-BNV	VN-BV	-	-
(6) V-FNV	-	-	V-FṼ

The Stop Voicing rule leads to neutralization between original voiceless and voiced consonants. Consequently, stops in this position will be reconstructed with capital letters: e.g. G means 'either *k* or *g*'.

2.4. We now turn to the nasal consonants of Proto-Ịjọ. If our previous argument is correct, there were no nasalized vowels in Proto-Ịjọ. Consequently, the three nasal consonants (*m n ŋ*) which are reconstructed at the systematic-phonetic level must also be reconstructed at the systematic-phonemic level, since they cannot be regarded as allophones of oral consonants conditioned by a following nasalized vowel.

Using C- to stand for the first consonant in a word (irrespective of whether or not it is preceded by a vowel) and -C- to stand for a later consonant, we find them distributed as in Table VII.

TABLE VII
DISTRIBUTION OF NASAL CONSONANTS IN PROTO-ỊJỌ
(first approximation)

	m	*n*	*ŋ*
C-	17	10	0
-C-	17	24	2

Table VII shows /m/ and /n/ well established in both C- and -C- positions, whereas /ŋ/ is recorded in only two items (in each case the second consonant out of three; cf. Appendix, items 9, 14). Lack of *ŋ*- is quite common in languages and probably does not require a language-specific explanation. But the rarity of -*ŋ*- calls for a historical explanation.

We propose that this explanation is simply that the -N- of CNV < CVNV structures is /ŋ/: thus we have Proto-Ijo

CVmV
CVnV
CVŋV > CŋV

Relating this to our earlier discussion means that all instances of modern CṼ or VN-CV are derived from Proto-Ịjọ (V-)CVŋV structures.

2.5. There are also, in modern Ịjọ, frequent instances of CṼṼ, where the two nasalized vowels are not identical. Rather than derive these from a trisyllabic structure CVŋV$_1$V$_2$, we propose that they come from a dissyllabic one: CV$_1$ŋV$_2$ > CṼŋṼ > CṼ$_1$Ṽ$_2$. This process can be observed repeating itself in modern Ịjọ speech-forms:

Nembe	*Bassan*	*Kolokuma*	*Mein*	
màŋgí	bàŋì	bã̀ŋĩ́ ~ bã̀ĩ̀	bã̀ĩ̀	'run'

If, then CṼṼ results from a sequence of *unlike* vowels, CŋV > CṼ must result from a sequence of *like* vowels. Thus we can now reconstruct modern CṼ < CŋV < CV$_1$ŋV$_1$.

This reconstruction establishes *-ŋ-* as a common non-initial consonant in Proto-Ịjọ.

2.6. There are also words in modern Ịjọ with the shape (V-)CVNCV. If we assume that the nasal in this position also results from metathesis, we shall reconstruct (V-)CVCVŋV. This increases the number of trisyllabic roots in the reconstruction (see items 3, 4, 42, 43 in the Appendix) and there are even quadrisyllabic ones (items 18, 22).

3. Comparison of PE and PI

3.1. In the foregoing sections we have made individual cases for *-ŋ-*, first in a Pre-Proto-Ẹdo stage, and then in Proto-Ịjọ. If these arguments are tenable, it should be possible to establish regular correspondences not only between Proto-Ẹdo *-mh-*, *-nh-* and Proto-Ịjọ *m, n* (Proto-Ịjọ has no lenis consonants), but also between Proto-Ẹdo Ṽ/ṼṼ and Proto-Ịjọ -VŋV. Our comparisons have revealed the correspondences set out below.

3.2. Proto-Ẹdo *-mh-* corresponds to Proto-Ịjọ *-m-*: for example:

ɛ-nhamhı	námá	'animal, meat'
u-thumhi	ò-tùmə̀	'tail'
ɗumhi	tòmĩ́/tèmĩ̀	'to pound'
ɗumhi	témí	'to pierce'

Proto-Ẹdo *-nh-* corresponds to Proto-Ịjọ *-n-*: for example:

ii-sʼĩə̃nhi	sɔ́ŋɔ́nɔ́	'five'
ɪ-nhĩãnhɪ	níŋínə̀	'eight'
i-tsienhi	è-s(í)éní	'nine'

Proto-Ẹdo *m-* corresponds to Proto-Ịjọ *m-*:

mi	mì	'squeeze'

Proto-Ẹdo *nh-* corresponds to Proto-Ịjọ *n-*:

ɛ-nhamhɪ	námá	'animal, meat'
ɪ-nhĩãnhɪ	níŋínə̀	'eight'

In the case of *-ŋ-*, we note the following correspondences:
Proto-Ẹdo CṼṼ corresponds to Proto-Ịjọ CVŋV:

-thãĩ	tɛ́ŋí (later tɛ̃ĩ)	'tree, stick'
-kĩə̃	ə̀-Gə̀ŋə̀ (later ə̀-Gŋə̀ > ạ̀-ŋgə̀ (cf. 2.3 above))	'egg'

Proto-Ẹdo ṼṼ corresponds to Proto-Ịjọ VŋV:

ii-sʼĩə̃nhi	sɔ́ŋɔ́nɔ́		'five'
ɪ-nhĩãnhɪ	níŋínə̀		'eight'
e-sʼĩə̃nhi	ì-Dìŋì	(later ì-Dŋì > ì-ndì)	'fish'

3.3. In Proto-Ẹdo, CṼ roots occur which are found by comparison with outside languages to be related to earlier CVŋV roots through the process of coalescence. In one such case. we found that

Proto-Ẹdo Ṽ corresponds to Proto-Ịjọ VŋV:

ɓũ	*ɓóŋì́	'be many'

3.4. It is obvious from the foregoing that for Proto-Ẹdo-Ịjọ (PEI), a velar nasal must be reconstructed, so that in PEI CVNV roots, -N- is one of *-m-*, *-n-* or *-ŋ-* (disregarding the fortis-lenis contrast for the moment).[5] Unlike Proto-Ẹdo, and some of the Ẹdo and Ịjọ languages, Proto-Ẹdo-Ịjọ lacked any significant vowel nasalization, and instances of significant nasalization occurring between the PEI level and these languages must be traceable to a lost nasal.

4. Comparison of Proto-Ẹdo, Proto-Ịjọ, and other 'Benue-Kwa' languages

4.1. The term 'Proto-Edo-Ijo' used in the previous section does not imply a protolanguage shared *exclusively* by these two groups. Like Greenberg himself (1969:39), and like other linguists (e.g. Stewart

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[5] Cf. section 4 below where we postulate lenis consonants for PBK on the basis of comparison with Stewart's Common (Volta-)Potou reconstructions.

1973:2), we suspect that instead of a separate 'Proto-Kwa' and 'Proto-Benue-Congo' we should rather postulate a single common protolanguage which, following Hyman (personal communication), we shall call 'Proto-Benue-Kwa'. This is equivalent in scope to Stewart's 'Volta-Bantu', although we reconstruct from a largely different range of languages.

4.2. The correspondence between Proto-Ẹdo -ṼṼ and Proto-Ịjọ -VŋV recalls Voorhoeve's (1975) observation that Proto-Bantu -VV corresponds to Proto-Benue-Congo -VŋV. This has led us to compare Proto-Ẹdo and Proto-Ịjọ with Proto-Lower Niger (i.e. Igbo and related speech forms), with Proto-Benue-Congo, and with some reconstructed and individual Benue-Congo languages (see the appendix for a full listing and sources). The correspondences noted from these comparisons are summarized in Tables VIII and IX. The last line gives our reconstructions for Proto-Benue-Kwa.

TABLE VIII

CORRESPONDENCES BETWEEN 'KWA' AND 'BENUE-CONGO' NASALS

Proto-Ẹdo (PE)	m	mh	n	nh	ṼṼ[6]
Proto-Ịjọ (PI)	m	m	n	n	ŋ
Proto-Lower-Niger (PLN)		m	n	n	Cn[7]
Proto-Plateau (PP)		m	n	n	ŋ
Proto-Jukunoid (PJ)	mb	m	nd		ŋ
Efik	m	m	n	n	ŋ
Ekoid (Ek)	m	m	n	n	ŋ
Mbam-Nkam (Mb-Nk)		m		n	ŋ
Proto-Bantu (PB)	m	m	n	n	VV[8]
Proto-Benue-Congo (PBC)		m	n	n	ŋ
Proto-Benue-Kwa (PBK)	m	mh	n	nh	ŋ

4.3. Table VIII shows that we postulate for PBK not only *m, n, ŋ*, but also *mh* and *nh*. In other words, the fortis-lenis opposition is postulated for PBK in nasals on the basis of our comparisons. There are two points that support this:

(1) In a number of cases, PE lenis reconstructions for stops are corroborated by Stewart's Common (Volta-)Potou evidence (cf. Stewart 1973).

(2) Although both the Potou Lagoon and the Ẹdo groups of languages are 'Kwa', comparison between PE and PJ suggests that such a distinction may have existed at the PBK level. Thus from Table VIII,

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[6] Cf. section 2 above.

[7] I.e. a consonant with nasal release/nasalization.

[8] **ŋ* disappears and nasalization is lost (Voorhoeve 1975).

TABLE IX: CORRESPONDENCES BETWEEN 'KWA' AND 'BENUE-CONGO' NON-NASAL CONSONANTS

PE		m	ɓ	th	t	ɗ	ts	s'	dh	kh	k	kp	f
PI	p	ɓ	B	t		t	s	s/D	l		k/G		f
PLN		m		d?	sh	s?	s	s/t	ɗ	j/g?	k	g?	f
PP		b	b	s/d		t?	t	t	d(y)	ti/k	ti	ti?	
PJ		b/mb		t			ky	t	d	k(y)	k(y)	k?	f
Efik	b?	m	b	s	y?	t		t	d	s/k?	k/s	kp	
Ekoid	p		b			dʒ?		t	l		k	gb?	
Mb-Nk	p		b			t		t	l/d			ŋgʷ	
PB	p	b/m	b		t?	t	t	t/c	d	g	k	g	
PBC	p	b	b	z				t/s	l	z	k	kp	
PBK	P	bh/-N	B	th	T	T	T	T	dh	kh	K	k(p)	f

PE m = PJ mb
n = nd (BUT see item 19 in Appendix)
mh = m

Unfortunately, there is no evidence from *nh* to clinch it; but we suspect that a deeper search would reveal a correspondence of the nature:

PE nh = PJ n

In support of PBK **m* we have items 24 and 33 in the Appendix; for **mh* items 1, 16, 20, 27, 28, 36, 38, 39, and 41; for **n* 5, 10, 17, 19, 25, and 35; items 1, 2, 9, 12, 14, and 31 clearly support **nh*.

There is overwhelming evidence in support of **ŋ*. No less than twenty items out of forty-three cited in the Appendix corroborate, with varying degrees of conviction, our postulation of PBK **ŋ*: typical items are 9, 14, and 17 (all numerals) and 7, 8, 11, 15, 21, 34, and 40.

4.4. In the case of non-nasal consonants, in which our interest was secondary, we have found, as shown above, evidence for postulating a fortis-lenis opposition at the Proto-Benue-Kwa level (cf. items 6, 11, 31, and 42 for **bh*; 34 and 38 for **th*; 3, 4, 22, 36, 39, and 42 for **dh*; and 12, 15, 40, and 41 for **kh*). Although we have reconstructed **bh*, **th*, **dh*, and **kh*, it is not in every case that Common (Volta-)Potou evidence can be drawn upon: in some cases we have depended only on the Ẹdo evidence. We do this because where we can check there is no case where (Volta-)Potou and Ẹdo differ in the fortis/lenis feature. Thus we have no evidence outside Ẹdo for postulating PBK **th* in our data, but we would expect this to be corroborated with fuller evidence. In some other cases, even though we have neither Ẹdo nor (Volta-)Potou evidence to draw on, we have nevertheless reconstructed lenis consonants where we felt that the scatter of reflexes suggests this.

Although there is no clear fortis/lenis evidence on the Benue-Congo side for non-nasals, it is interesting to note that, in a nasal environment, our **bh* behaves differently from *B in some Benue-Congo languages (see items 6, 11, and 42 for **bh* and 2 and 43 for *B).

*P, *B, *T, and *K represent a series of incomplete reconstructions from correspondences whose evidence is not conclusive. This was unavoidable since our data was collected with our specific (nasal) interest in mind. Still, they do give a fair idea of the place of articulation and the state of the glottis (cf. Table IX).

We have only one item each for P (43), *k(p)* (21), and *f* (37). But we have at least four series of correspondences for T and one would need more data to sort out the picture. K is reconstructed in items 3, 4, 8, 19, 32, and 35.

4.5. The comparisons have shown that (1) we can reconstruct not only *m, n, ŋ*, but also *mh, nh* for PBK; (2) the fortis-lenis opposition evident in the *m* - *mh* and *n* - *nh* contrasts is to be found also in the non-nasal consonants postulated for PBK.

5. Conclusions

5.1. The importance of reconstruction within closely-related groups for the purpose of confirming or modifying a classification cannot be overemphasized. For example, the Ẹdo languages have always been regarded as typical of Kwa, and the assumption from the days of Westermann (1927:73) that Kwa languages have basically monosyllabic roots has tended to discourage the search for correspondences beyond the initial consonant and first vowel. Although it has been assumed that nasalized vowels reflect some kind of original second-syllable nasal, no attempt has been made to determine which nasal or nasals occurred in the protolanguage. We have tried to show here that investigation of this area is profitable not only for groups like Ịjọ which tend to preserve second syllables but also for those like Ẹdo which tend to reduce them. We suggest that this process can be extended to groups like Lower Niger which show even further reduction: e.g. in all cases where PLN shows a cognate to **ŋ*, it is represented by nasalization (*n*) after a consonant; whereas in two clear cases of cognates to **mh* (items 1 and 39; BUT cf. 38), the only trace left is rounding of the preceding vowel.

We have postulated four nasals (*m n mh nh*) in C- position and three (*ŋ mh nh*) in -C- position. The Ẹdo evidence suggests there was no fortis/lenis contrast in -C- position; evidence to support or modify this should be sought in other languages. Stewart (1973) does not suggest a fortis/lenis contrast in nasals.

Once longer roots have been reconstructed for Kwa, Kwa languages look increasingly similar to Benue-Congo ones. If Kwa and Benue-Congo languages can no longer be separated on the customary typological grounds, such as monosyllabic roots (e.g. Westermann and Bryan 1952:90-94, especially point 4), nor on lexical grounds (cf. BCCW), nor on the evidence of noun classes (cf. De Wolf 1971 and Elugbe (forthcoming)), then we conclude that, pending the production of new types of evidence, Benue-Congo and Kwa form a single subfamily of Niger-Congo.

Appendix

Items are cited alphabetically by the English gloss, in the following order:

PE	Proto-Ẹdo, based on Elugbe 1973 with revisions
PI	Proto-Ịjọ, based on Williamson (unpublished notes)

PLN	Proto-Lower Niger (i.e. Igbo, Ẹkpeye and closely related speech forms), based on Williamson 1973b with revisions. Cn represents a stop with nasal release or a nasalized consonant
PP	Proto-Plateau, based on Gerhardt 1967-70 and 1974. Items which are reconstructed for subgroups of PP are cited as follows (numbering reflects Gerhardt's proposed subgrouping): 1a. PP-4 = Proto-Plateau 4 b. PP-2 Kag = Kagoro group (of Plateau 2) 2a. PP-2 Jab = Jaba group (of Plateau 2) b. PP-3 = Proto-Plateau 3
PJ	Proto-Jukunoid, based on Shimizu 1971. Items reconstructed for subgroups of PJ are cited thus: PCJ = Proto-Central Jukunoid PJMW = Proto-Jukun-Mbembe-Wurbo
Efik	Efik from Cook 1969, Welmers 1968, and Adams 1952, 1953. The transcription is systematic-phonetic
Ek	Ekoid, based on the pseudo-reconstructions in Voorhoeve 1967 except where marked Ght, which refer to those in Gerhardt 1974, or W., suggested here by Williamson: ultimate source for all pseudo-reconstructions is Crabb 1965
Mb-Nk	Mbam-Nkam (otherwise known as Bamileke, see Voorhoeve 1971), based on the pseudo-reconstructions in Voorhoeve 1967 except where marked Hym, which refer to those in Hyman (personal communication)
PB	Proto-Bantu, based on the Common Bantu reconstructions in Guthrie 1967-71 (Gt) or the PB reconstructions in Meeussen 1969 (Ms)
PBC	Proto-Benue-Congo, based on the reconstructions in De Wolf 1971 (nouns only)
PBK	Proto-Benue-Kwa reconstructions proposed by the authors (consonants only)
PWS	Proto-West Sudanic, based on the reconstructions in Westermann 1927
Grb.	root cited in Greenberg 1963 as Proto-Niger-Congo (no reconstruction proposed)
Ar.	root cited in Armstrong 1964 as ancient, though not invariably Proto-Niger-Congo (no reconstruction proposed)
BCCW	Benue-Congo comparative wordlist (Williamson and Shimizu 1968, Williamson 1973c), reference by volume and page. Not all roots are Proto-Niger-Congo

A question mark preceding a form indicates doubt of its cognation with the item in question; a question mark following a reconstruction indicates doubt of the reconstruction.

	1 *Animal/Meat*	*Ashes* see *Dust*	2 *Break/Snap*
PE	ɛ-nhamhı		ɓunhi 'break a stick'
PI	námá		
PLN	-nû		
PP	niam 'animal'		but PP-4 mun PP-2 Jab bun
PJ			
Efik	ú-nàm		búŋ
Ek	-nyàm		Ght. -bun 'break by snapping'
Mb-Nk	nàm 'animal'		
PB	Gt. -yàmà/-nyàmà 9		Gt. -bụn-
PBC	-nama ì-/í-		
PBK	-nh-mh-		B-nh-
PWS	-nìàm-, -nàm-		
Grb.	Grb. 1		
	Ar. 80		
BCCW	I.4 root 1		

	3 *Charcoal*	4 *Crab*	5 *Defecate*
PE			nə
PI	á-Gáŋálá 'mangrove, charcoal'	á-káGáŋá	
PLN			
PP	tian	PP-4 ì-kaŋ í-	
PJ	-kán	-kaŋ ki-/i-	
Efik	ú-káŋ	ŋ́-kóŋó	
Ek		-kal	
Mb-Nk			
PB	Ms. -kádà 5	Ms. -kádá 9	Ms. -nè-
PBC	-tiadana li-	-kala ku-/í-	
PBK	-K-dh-ŋ-	-K-dh-ŋ-	n-
PWS	-kà, -kàn-, -kàl-	-ka-, -kal-	nia 'cacare'
Grb.			
Ar.	Ar. 42		
BCCW	I.64, root 1	I.92, root 1	

	6 *Dust/Ashes/Sand*	7 *Ear*	8 *Egg*
PE	ɪ-mʋɛ 'ashes'	ʋ-s'ɔʋ	-kĩə̃
PI	í-wòŋú (w-?) 'sand'		ə̀-Gə̀ŋə̀
PLN		ń-tnì	ʋ̀-kwnâ
PP	buŋ 'dust'	PP-4 ku-tóŋ PP-2 Kag two PP-2 Jab gu-toŋ PP-3 toŋ	PP-2 Kag tii PP-2 Jab -zeŋ PP-3 tii
PJ	-búŋ̀ u-/i 'sand, dust'	-tóŋ ku-/a-	-kyì ri-/a-
Efik		ú-tɔ́ŋ	?ŋ̀-kwà (Ibibio)
Ek		-tôŋ	?-gí
Mb-Nk		tɔ́ŋ	
PB		Ms. -túị 15	?Ms. -gi (and -gidí?)
PBC		tuŋ i ku-/a-	-kiŋ/-tiŋ li-/a-
PBK	-bh-ŋ-	-T-ŋ-	-K-ŋ-
PWS			-gì-, -gìa-
Grb.		Grb. 17	
Ar.			Ar. 22 (and p. 74)
BCCW	(cf. I.20, root 1 and commentary)		I.132, root 3 (and root 1?)

	9 *Eight*	10 *Elephant*	11 *Excrement/Faeces*
PE	ɪ-nhĩãnhɪ	-ni	
PI	níŋínə̀		ɓíŋɛ́ 'defecate, buttocks'
PLN		é-nyî	
PP		PP-4 ì-ni í-	biuŋ
PJ		-ndìT i-/i-	-byíŋ a-
Efik		é-nɛ̀n/é-nìn	
Ek			
Mb-Nk			
PB-1	-náàna		Ms. bị́ị 13, 6
PBC		-ni ì-/í-	-biŋ a-
PBK	-nh-ŋ-nh-	-n(-N) (?)	-bh-ŋ-
PWS	-ní, -nía	-ni-	(m-)bi, (m)-bin-
Grb.			
Ar.		Ar. 75	
BCCW	II.440, root 1	I.136, root 2	

	12 *Fight* v.	13 *Fish*	14 *Five*
PE	khɔnhı	e-sʼĩẽnhi	ii-sʼĩẽnhi
PI		ì-Dìŋì	sɔ́ŋɔ́nɔ́
PLN	(cf. *War*?)	á-znʋ̀	ì-snó
PP	(cf. *War*)		twon PP-3 tuŋun
PJ	-káǹ ri-/a- 'war' n.		-ton i-
Efik	(cf. *War*?)		ì-tíòn
Ek		?-tí	-tân
Mb-Nk			-tɔ̂n
PB		Ms. -cụ̂ì	Ms. -táánó` (t/c, o/u)
PBC		-sidi ì-/í-	
PBK	kh-nh-	-T-ŋ-nh-	-T-ŋ-nh-
PWS			-nú-
Grb.		Grb. 21	
Ar.			Ar. 79
BCCW			II.428, root 1

	15 *Fly* n.	16 *Forget*	17 *Four*	18 *Fry/Roast*
PE	-khĩə̃	s'amhı	-niə	
PI			ì-nóŋí	kpágáŋàná (?)
PLN	-jní		ì-nɔ̂	
PP	tiuŋ		nas PP-2 Jab naŋ	
PJ	-kyíŋ̀ ki-/i		-ndin i-/-a	kán
Efik	ń-sùŋ		ì-nàŋ	káŋ
Ek			nɛ̂	W. kaaŋe
Mb-Nk				
PB	Ms.-gị̀		Ms. -nàị̀	Ms. -kadịng-, -kadang- 'roast on coals'
PBC	-zin ì-/í-			
PBK	-kh-ŋ-	T-mh-	-n-ŋ-	k-D-ŋ-(n̩-) (?)
PWS		ta (+ Nasal)	-ni	
Grb.	Grb. 22		Grb. 23	
Ar.			Ar. 68	
BCCW			II.106, root 1	I.176, root 1 II.296, root 1

	19 *Give*	20 *I*	21 *Leopard*
PE	nə/niə	mhV	ɛ-kpɛ
PI			
PLN	nyé	mʋ	? -gnʋ̀´
PP	nwaak		
	PP-2 Kag naŋ 'give dash'	Jaba-Koro mi	? tii
PJ	-na		? -kù i-/i-
Efik	nɔ̀	àmì	? é-kpɛ̀
Ek			? -gbɛ̀
Mb-Nk			ŋgwì
PB Gt.	-ni̥ŋk-/-yi̥ŋk-	Gt. -mé/-mí	Ms. -gòi̥ 9
PBC			-kpoŋi ì-/í-
PBK	n-ŋ-K-	mh-	-k(p)-ŋ-
PWS	ná	mì	-guí-
Grb.	Grb. 24		Grb. 30
Ar.			
BCCW	I.180, root 3 (and 2?)		I.224, root 1

	22 *Long*	23 *Many*	*Meat* see *Animal*	24 *Mould* v.
PE		ɓũ		ma
PI	ɗágáŋàlʋ́	ɓóŋì´		
LN				
PP				
PJ				mbya 'mould, build'
Efik	níɔ́ŋ			
Ek				mɔ̆ŋ
Mb-Nk				
PB	Ms. -dài̥			
PBC				
PBK	dh-(C-)ŋ-(D-) ?			m-ŋ-
PWS				
Grb.	Grb. 31			
Ar.				Ar. 56
BCCW				II.244, roots 2, 3

	25 *Mouth*	26 *Nine*	27 *Pierce*	28 *Pound*
PE	-nuə	i-tsienhi	ɗumhi	ɗumhi
PI		é-s(í)éní	témí	tòmì/tèmì
PLN	ɔ́-nʋ̀´			?-sʋ
PP	nu PP-4 nụŋ/nyụŋ PP-2 Kag nu(ŋ)		?tup ‘stab’	
PJ	-ndut u-/i-			
Efik	í-nùà			tím
Ek			?W. -dʒim ‘sew, pierce, jab’	
Mb-Nk			Hym tím ‘sew’	
PB	Ms. -nùà		Gt. -tụ́m- ‘sew, stab’	?Gt. -tú-
PBC	-nuŋa ú-/ti-			
PBK	-n-ŋ-		T-mh-	T-mh-
PWS	-ni			
Grb.	Grb. 23			
Ar.	Ar. 68			
BCCW	II.106, root 1		II.316, roots 2, 4 ‘sew’	

	29 *Roast*	30 *Saliva*	*Sand* see *Dust*	31 *See*
PE	tɔ̃	a-tsɪãĩ		mɪnhɪ
PI				
PLN	shnʋ	ɛ́-snʋ́ (-ʋ/a/ɔ)		
PP		PP-4 á-nte PP-2 Kag tyak PP-3 tay		
PJ		PJMW -kyáŋ		
Efik	? yɔ̀ŋɔ́			mɔ̀nɔ́
Ek				
Mb-Nk				
PB	?Gt. -tụ̀mb- ?Gt. -tụ̀ụ̀mb- ‘burn’	Ms. -táị 6		Ms. -bón (b/m)
PBC		-(n)tani ma-		
PBK	-T-ŋ- ?	-T-ŋ-		bh-nh-
PWS	tùà, tọ̀	-tá-		
Grb.		Grb. 37		
Ar.				
BCCW	II.296, root 2			

	32 *Smoke*	*Snap* see *Break*	33 *Squeeze/ Wring*	34 *Stick/ Tree*	35 *Stranger/ Hospitality*
PE			mi	*v*-thãĩ	
PI	è-gèŋù (?)		ìmì	téŋí	ì-gònì
PLN	έ-ŋwʋ̀ɗʋ̀				
PP	tiuŋ			PP-2 Kag sian 'stick'	PP-4 ù-can PP-2 Kag tien PP-2 Jab -tsen
PJ	kyáŋ ma-				-kìn u-/ba- 'guest, journey'
Efik	ń-sùŋ í-kàŋ		mìŋ	é-sáŋ 'walking-stick'	è-sɛ́n 'strange, alien'
Ek					Ght. jɛ́n+V
Mb-Nk					
PB			Ms. -mi̧n-		Ms. -gèni̧ 1
PBC					-kena ù-/ba-
PBK	-K-ŋ-		m-ŋ- ?	-th-ŋ-	-K-n-
PWS			mí, míná		
Grb.					
Ar.					
BCCW			Cf. II.272, root 5		

	36 *Swallow* v.	37 *Swell*	38 *Tail*	39 *Tongue*
PE		fũə̃	u-thumhi	*v*-dhamhı
PI	mɛ̀nì	fúŋə́	ò-tùmə	
PLN		fnʋ̀/fnù	? ɔ́-dnʋ̀	í-ɗô
PP	PP-4 mir		dum	dyam
PJ	mèn	PCJ fùN	-tum 'horsetail'	-dèma ri-/a-
Efik	mɛ̀n		ì-sìm	é-dɛ̀mɛ̀
Ek				-lebi
Mb-Nk				Vh. lém Hym. dím
PB	Gt. -mèn-/-mèd-/ -mì̧d-/-mì̧n-			Ms. -dímì̧ 11
PBC			-zum ku-/a-	-lemi li-/a-
PBK	mh-dh-	f-ŋ-	-th-mh-	-dh-mh-
PWS	mì, mìn-			-lima
Grb.				Grb. 45
Ar.	Ar. 65			Ar. 35
BCCW				II.372, root 1

	Tree see *Stick*	40 *Walk*	41 *War* (cf. *Fight*)	42 *Water*	43 *Wing*	*Wring* see *Squeeze*
PE		khĩã	ʋ-khʋmhɪ	a-mɪ		
PI				ɓèDìŋì	pàBàŋà	
PLN			? ɔ̀-gnʋ̀	ḿ-míɗì ´		
P			PP-4 ì-kóm			
PJ		kyàŋ		mbyed		
Efik		sàŋá	? é-kɔ́ŋ	ḿ-mɔ́ŋ	ḿ-bâ	
Ek				B m̀-màl M à-lɔ́b	-pàb	
Mb-Nk					bàb ´	
B					Gt. pàpá -bàbá 5/6, 11/10	
PBC					-babaŋ/-pabaŋ li-/a-	
PBK		kh-ŋ-	-kh-mh- ?	-bh-dh-ŋ-	-P-B-ŋ-	
PWS		kia(+ Nasal)				
Grb.						
Ar.				Ar. 63 (in part?)		
BCCW			(cf.II.396, root 2)	II.388, root 7	II.404, root 1	

Commentary

1. ANIMAL/MEAT. The forms with *ny-*, *y-*, *-i-* are attributed to the class prefix *i-* (cf. Meeussen 1963). The lenis first consonant is confirmed by Common Potou *ã́'dã́* (Stewart 1973).
2. BREAK/SNAP. Evidence is for alveolar second nasal, except for Efik. For PP *-t* instead of *-n*, cf. PIERCE.
3. CHARCOAL. Our proposed reconstruction accounts directly for forms like Birom *hwalaŋ* (BCCW). In PB, loss of a third syllable beginning with *-ŋ-* is paralleled in CRAB and WING. Forms like *-kan* can be accounted for by assimilation in nasality of *-dh-* to the *-ŋ-* before it was lost. Ịjọ, Efik, and Ufia *ì-kààlà* (BCCW) presuppose metathesis of the second and third consonants. For PP *ti-* = K-, cf. EGG, FLY n., SMOKE, STRANGER. We suspect the PBC reconstruction might be revised, but like ours it assumes three original consonants.
4. CRAB. Even if this did not have exactly the same consonants as CHARCOAL, they must have been very similar. We assume metathesis of the last two consonants in PP-4, PJ, and Efik; assimilation of the alveolar to the two velars in PI; and loss of the final syllable in PB (cf. CHARCOAL) and Ek. Oddly, PP shows *k-* here for regular *ti-*; cf. under CHARCOAL.
5. DEFECATE. We suspect this item is more widely distributed than our forms show, but even the present examples show it is Proto-Niger-Congo.
6. DUST/ASHES/SAND. Original meaning probably 'dust' or 'sand', as there is a root which we would reconstruct as PBK -T-ŋ- for 'ashes' (BCCW I.20, root 2). We believe our root *-bh-ŋ-* is *not* cognate with Efik *ó-bû* 'ashes, dust', Ek. *-bubu* 'dust', Mb-Nk. *bvɔ́* 'ashes', PB *-bụ́* (*-bu*) 'earch, dust' (Ms.), and PBC *-bubu ka-* 'dust, earth, mud', for these show no trace of a nasal and appear to be cognate with PE *-ɓu-* 'sand, dust'; i.e. we postulate two roots, one with and one without nasal, both being found in PE. PI shows W-(?) for expected *ɓ-*.
7. EAR. The evidence for *-ŋ-* is completely regular.
8. EGG. Although PJ is reconstructed without a nasal, there are several reflexes which show nasalization. Efik (or Ibibio) and Ek. would have been expected to show a double vowel; possibly these belong to a second root: the *g-* of Ek and PB and the *kw-* of PLN and Ibibio are also unexplained.
9. EIGHT. Excellent evidence for *-ŋ-*.
10. ELEPHANT. The second consonant is not certain. *ny-* in PLN must result from the adjacent *-i*.
11. EXCREMENT/FAECES. Although Westermann reconstructs *-n-*, some of the forms he cites and all the other evidence here suggests *-ŋ-*. The lenis *bh-* is supported by Common Volta-Potou *'biỹ* resulting in Cama *'bi,* Akan *bĩŋ* (Stewart 1973).
12. FIGHT. V. The rather slender evidence cited is confirmed by Volta-Potou *'kụ̃* (Stewart 1973). A similar root, but showing *-mh-*, is postulated for WAR, q.v.
13. FISH. Common Potou *á'cɔ̃̀* (Stewart 1973) suggests the first consonant was lenis and palatal, but the palatality could be due to the old *i-* prefix; the voicing in PLN is unexplained. Evidence for *-ŋ-* is clear in PE, PI, PB, and some of the forms cited by Greenberg. The only evidence for *-nh-* is PE, but

the PBC reconstruction, though it does not agree fully with ours, at least suggests an alveolar.

14. FIVE. Probably the palatalization of T- was due to the *i*- prefix (Meeussen 1963). Evidence for -*ŋ*- is clear in PE, PI, PP-3, and PB; the -T-*n*- forms have either lost -*ŋ*- (cf. the two (phonetic) vowels of Efik) or possibly undergone assimilation of the velar to the surrounding alveolars.
15. FLY. n. Palatalization of the first consonant is probably due to the *i*- prefix. For PP *ti* = K, cf. under CHARCOAL. -*ŋ*- is clearly attested in PE, PP, PJ, and Efik, and most of the Grb. forms are nasalized; we suspect -*ŋ* rather than -*n* for PBC.
16. FORGET. Might prove more widely distributed if looked for.
17. FOUR. Evidence for -*ŋ* in PE, PI, PP-2 Jab, Efik, PB, Grb., and Ar.; PJ, Ek irregular.
18. FRY/ROAST. For the meaning, cf. ROAST (29). Obviously an old root is reflected here, but its form is uncertain; cf. BCCW II.296 for some discussion. PI *kp*- is unexplained, also PB -*ng* (not the regular reflex of -*ŋ*). Metathesis may be involved; cf. CHARCOAL , CRAB.
19. GIVE. *n*- clear, except that PJ irregularly shows *n*- instead of *nd*-, and PLN *ny*- for *n*. We suggest tentatively that the original consonants may have been -*n*-*ŋ*-K-; loss of -*ŋ*- would give the PP form, loss of -K- the PP-2 Kag form; loss of the vowel between -*ŋ*- and -K- might account for the otherwise irregular Bantu correspondence.
20. I. Clearly Proto-Niger-Congo; probably exists in some groups where it has not yet been reconstructed. PI is unusual in having no trace of it.
21. LEOPARD. Clearly a genuine old root, although its exact shape is not yet clear. First consonant either velar or labial-velar; for PP cf. under CHARCOAL. PJ, Efik, Ek irregularly lack -*ŋ*; the preceding *ŋ*- of Mb-Nk may be a metathesized remnant of the old -*ŋ* . PE compared with PBC shows vowel coalescence; cf. section 3.3 above.
22. LONG. The original form is not yet clear. Bariba, cited by Grb., attests to an original nasal, as do PI, Efik, and PB.
23. MANY. Cannot be reconstructed beyond PEI.
24. MOULD. v. Strong evidence for *m*-, but -*ŋ* depends solely on Ek. The Ek form is almost certainly a reflex of this root and not of PB -*búmb*-, for *bh*- does not become Ek *m*-; cf. EXCREMENT/FAECES, and perhaps WATER.
25. MOUTH. Evidence for *n*- clear. Evidence for -*ŋ* in PE, PP-4, PP-2 Kag, PB, and PBC. Efik, surprisingly, has lost it and preserved the two vowels; PJ -*t* irregular.
26. NINE. No evidence beyond the PEI level.
27. PIERCE. Irregular correspondences in C- between PE and PI, also Ek. PP shows -*p* for expected -*m*; otherwise, reasonably clear. Cf. POUND.
28. POUND. Cf. PIERCE. PB lacks -*m* and may not be cognate.
29. ROAST. This root is not clear. PE suggests -*ŋ*, but apart from the indecisive evidence of PLN this is not well supported. *y*- of Efik makes cognation doubtful, PB shows -*mb*-, unless we reconstruct Pre-Bantu *-*tụŋụmb*- 'burn'; PWS forms do not suggest nasalization; BCCW forms suggest -*n*-, unless Pinyin *tɔ́ɔ́nə̀* goes back to **tɔŋɔnə*.
30. SALIVA. Evidence not completely clear. PE, PJMW, PB suggest -*ŋ*-; prenasalization in PP-4 and PBC is suggestive, and PP-2 Kag -*k* suggests

denasalization (cf. PIERCE). But PBC suggests *-n-* rather than *-ŋ-*, and PWS, Grb. forms do not suggest nasalization.

31. SEE. We assume *bh-* > *m-* in Pre-PE and Efik before a nasal; cf. DUST, WATER.
32. SMOKE. Although not completely regular, this suggests an old root. PI is irregular and the reconstruction is debatable. PLN *ŋw-* is perhaps a collapsing of K*ŋ-*, and the last syllable an addition. The last word of the Efik form means 'fire'.
33. SQUEEZE. *m-* is clear; the second consonant not. Efik is supported by Akpet (BCCW); elsewhere *-m-* or *-n-* is suggested. Double vowels in e.g. Abua *-miim*, Yakur *míìná*, suggest there could have been earlier forms **miŋi-m*, **miŋina,* etc.
34. STICK/TREE. We suggest this root is distinct from the non-nasalized *-ti* 'tree' root of PNC, and (especially in view of Efik) that its original meaning was 'stick'. Possibly connected, although not corresponding regularly, are PBC *-taŋga ú-/ti-* 'stick, whip', and PB *-tonga* 3 'stick' (Ms.).
35. STRANGER/HOSPITALITY. Second consonant clearly *-n*. Voicing of C- in PI, PB, Ek; other forms suggest voiceless consonant.
36. SWALLOW V. *mh-* reconstructed on the basis of PJ, cf. 4. Some evidence, both here and in Ar., that the second consonant was not originally nasal. We postulate a lenis *-dh* which was commonly nasalized by the *m-*.
37. SWELL. A rather clear case.
38. TAIL. If PLN is cognate, nasalization there can originate from a bilabial as well as a velar nasal, as the other forms all attest a bilabial.
39. TONGUE. Both consonants clear. Lenis *dh-* confirmed by Common Potou *á'd*ɛ́ (Stewart 1973).
40. WALK. Few examples, but clear.
41. WAR. Cf. FIGHT V., which clearly shows an alveolar nasal and is probably cognate with BCCW II.396, root 2. Here PE and PP-4 clearly show a bilabial; Efik, oddly, shows a velar, and PLN either a velar or possibly a bilabial (cf. TAIL). Unclear.
42. WATER. The first two consonants are suggested by PI, PLN, PJ, and Ek (we assume metathesis in languages like M). Cf. Delta Ẹdo à-mìnì, which is possibly the older form although there is no clear trace of the last syllable in other branches of Ẹdo. The *-ŋ* is suggested by PI and by Plateau languages such as Kagoma *malaŋ*, Piti *mɪnɪŋ*; it would account for the frequent all-nasal shape of the word if we assume it influenced the earlier consonants before being lost.
43. WING. The PI and PBC forms, reconstructed quite independently, attest the basic shape of this root. P-B- will yield P-P- or B-B- by assimilation in voicing. In PB, a third syllable of shape -ŋV drops; cf. CHARCOAL, CRAB.

Adams, R.F.G. 1952. *English-Efik Dictionary.* (ed. 3 revised). Liverpool.

Adams, R.F.G. 1953. *Efik-English Dictionary.* (ed. 3 revised). Liverpool.

Armstrong, R.G. 1964. *The Study of West African Languages.* Ibadan.

Cook, T.L. 1969. *The Pronunciation of Efik for Speakers of English.* Bloomington: African Studies Program and Intensive Language Training Center, Indiana University (mimeographed).

Crabb, D.W. 1965. *Ekoid Bantu Languages of Ogoja, Part I.* (West African Language Monographs 4). Cambridge.

De Wolf, P.P. 1971. *The Noun Class System of Proto-Benue-Congo.* (Janua Linguarum, series practica 167). The Hague and Paris.

Elugbe, B.O. 1973. *A Comparative Ẹdo Phonology.* Ph.D. diss., University of Ibadan.

Elugbe, B.O. Forthcoming. "Noun class vestiges in Dẹgẹma".

Gerhardt, L. *Beiträge zur Kenntnis der Sprachen des nigerianischen Plateaus.* Hamburg (mimeographed).

Gerhardt, L. 1967-70. "Analytische und vergleichende Untersuchungen zu einigen Zentral-nigerianischen Klassensprachen". *Afrika und Übersee* 51.161-98; 52.23-57, 125-43, 207-42; 53.44-65.

Greenberg, J.H. 1963. *The Languages of Africa.* International Journal of American Linguistics 29,1 Part 2 and The Hague.

Guthrie, M. 1967-71. *Comparative Bantu.* (4 volumes) Farnborough, Hants.

Hyman, L.M. 1972. "Nasals and nasalization in Kwa". *Studies in African Linguistics* 3.167-205.

Lindau, M. 1975. *Features for Vowels.* Ph.D. diss., University of California, Los Angeles.

Meeussen, A.E. 1963. "Isolated features in Proto-Bantu". Paper read at Third West African Languages Congress, Freetown.

Meeussen, A.E. 1969. "Bantu lexical reconstructions". Tervuren (manuscript).

Shimizu, K. 1971. *Comparative Jukunoid: an Introductory Survey.* Ph.D. diss., University of Ibadan.

Stewart, J. 1967. "Tongue root position in Akan vowel harmony". *Phonetica* 16.185-204.

Stewart, J. 1973. "The lenis stops of the Potou Lagoon languages and their significance for pre-Bantu reconstruction". *Research Review* (Institute of African Studies, University of Ghana), Supplement 4, 1-49.

Voorhoeve, J. 1967. "Ekoid-Bamileke-Bantu". Paper for Benue-Congo Working Group, 7th West African Languages Congress, Lagos (mimeographed).

Voorhoeve, J. 1971. "The linguistic unit Mbam-Nkam (Bamileke, Bamum and related languages)". *Journal of African Languages* 10,2.1-12.

Voorhoeve, J. 1975. "Bantu noun classes and morpho-semantic comparison". (Preliminary version). To appear in: *Noun Classes in Grasslands Bantu*, L.M. Hyman and J. Voorhoeve edd. Paris: Société pour l'étude des langues africaines.

Welmers, W.E. 1968. *Efik.* Occasional Publication 11, Institute of African Studies, University of Ibadan.

Westermann, D. 1927. *Die westlichen Sudansprachen und ihre Beziehungen zum Bantu.* Berlin.

Westermann, D. and M.A. Bryan. 1952. *The Languages of West Africa.* London.

Williamson, K. 1973a. "More on nasals and nasalization in Kwa". *Studies in African Linguistics* 4.115-38.

Williamson, K. 1973b. "The sound system of Proto-Lower Niger". Paper read at the 4th Conference on African Linguistics, Queen's College, CUNY (mimeographed).

Williamson, K. (ed.). 1973c *Benue-Congo Comparative Wordlist: Volume II.* West African Linguistic Society, Ibadan.

Williamson, K. and K. Shimizu (edd.). 1968. *Benue-Congo Comparative Wordlist: Volume I.* West African Linguistic Society, Ibadan.

Some Questions regarding Universal Phonetics and Phonetic Representations

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At the time when many linguists believed that "languages could differ from each other without limit and in unpredictable ways" (Joos 1957:96) and that "the only really secure generalization on language that linguists are prepared to make is that 'some members of some human communities have been observed to interact by means of vocal noises.'" (Fillmore 1968), Greenberg was calling attention to the existence and importance of language universals. The 'Memorandum Concerning Language Universals' presented to the historic Dobbs Ferry Conference on April 13-15, 1961 by Greenberg and his co-organizers, Osgood and Jenkins, started with the assumption that "underlying the endless and fascinating idiosyncrasies of the world's languages there are uniformities of universal scope. Amidst indefinite diversity, all languages are, as it were, cut from the same pattern." (Greenberg 1963:255).

Exactly six years later (April 13-15, 1967) a second symposium on 'Universals in Linguistic Theory' was held in Texas. By the time of this second conference there was not only acceptance of the universal 'uniformities' but also a denial that 'indefinite diversity' was possible. The search for linguistic universals was no longer merely an interesting area for exploration but was seen to constitute the basic aim of linguistic theory. The goal was "to discover what is common to all languages, what is essential in the notion 'natural language', what are the limits within which

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languages can vary, what are the (universal!) terms by means of which this variation can be described." (Bach and Harms 1968:vi).

In neither of these conferences was the question of universal phonetics considered as a special topic. This may have been due to the fact that in the history of linguistics "analysis of actual practice shows no exceptions to the reliance on phonetic universals" (Chomsky 1964:92). The historic interest in universal phonetic alphabets is evidenced in Wilkins' proposals in 1668 and Lodwick's attempt in 1686 to construct "an alphabet which should contain an enumeration of all such Single Sounds or Letters as are used in any Language". Even Firth in arguing against "an a priori system of general categories by means of which the facts of all languages may be stated" (1957:144) exempted phonetics from his 'anti-universalist' position stating that "the descriptions of pronunciations in phonetic terms at the phonetic level only do not form part of a given language system, since the categories of phonetics are inter-lingual, 'international'" (1957:145).

Despite the assumption of a universal phonetic theory on which all phonetic representations of utterances are based, until recently in American linguistics, there has been little discussion on the nature of this theory. As a result, there has been relatively little discussion on the nature of phonetic representations in grammar as compared, for example, to the discussion and debate concerning phonological representation. Generally it has been assumed that the phonetic representation of words or sentences is "essentially de Saussure's 'phonologie' or the 'narrow transcription' of the British phoneticians . . . or Sapir's 'phonetic orthography'" (Chomsky 1964:187). This is, for the most part, the accepted view whether this phonetic representation is the output of the phonological component as in 'standard' generative phonology or the lexical representation as in the models proposed by Vennemann (1971, 1972), Hooper (1973) and more recently Leben (1975).

Historically all linguists have agreed that phonetic representations can not be equated with the physical records of the speech signal, since all instrumental and experimental phonetic research has shown that no two utterances are ever physically identical.

The recognition of this fact led Saussure to emphasize that the 'sound image' is "not the material sound, a purely physical thing, but the psychological imprint of the sound, the impression that it makes on our senses" (1960:66a). It formed the basis for Trubetzkoy's separation of the study of sound into two disciplines: phonetics, "the study of the sound of the speech event (parole)" and phonology "the study of the sound of the system of language (langue)", a position reiterated by Bloomfield who was of the opinion that "the physiologic and acoustic description of acts of speech belongs to other sciences than ours" (1926). It is clear, however, that an examination of Trubetzkoy's work reveals that his phonetics referred to physical phonetics, and his phonology included the phonetic representations of generative phonology. In similar fashion, Sapir noted that despite the great variation in the physical signal each time the 'same' utterance is pronounced by a single speaker, or different speakers ". . . the relations that obtain between the elements in the two patterns are the same" (Sapir 1925). But, the 'two patterns' refer not to the physical differences but differences in the phonetic patterns. Phonetic patterns are thus also abstractions from the infinitely varying physical signals. To obtain such phonetic representations linguists are compelled to abstract certain necessary parameters from the totality of collected or observed data and reject others as contingent. The problem then is to determine what are the necessary parameters. If "phonetic transcription is . . . not a direct record of the speech signal, but rather . . . a representation of what the speaker of a language takes to be the phonetic properties of an utterance . . . (i.e.) the speaker-hearer's interpretation rather than directly observable properties of the signal" (Chomsky and Halle 1968:294), we are still left with the problem of determining what a speaker "takes to be the phonetic properties" and how to specify these properties in a phonetic representation.

The problem was essentially ignored by Bloomfield and others who followed his view that phonology "pays no heed to the acoustic nature of the phonemes, but merely accepts them as distinct units" (1933) thereby concluding that a "record in terms of phonemes [should ignore] all features that are not distinctive in the language". He did however point to the fact that "any combination of phonemes that occurs in a language is pronounceable in this language and is a phonetic form". The nature of this phonetic form was assumed but not explicated.

Similarly, the problem was ignored by Hjelmslev (1947) who went so far as to reject the idea that a phoneme is a phonetic abstraction at all stating that "linguistics describes the relational pattern of language without knowing what the relata are", concluding that "linguistics . . . must establish the science of expression without having recourse to phonetic . . . premises" (1943:79). Even he, however, *assumed* a phonetic representation when he later admitted "that the elements are set up by considering the interplay between form and substance" (Fischer-Jørgensen 1964:9).

Phonetic representation, however, constitutes part of the form as well as the substance of language, and by relegating phonetics to physical 'substance' the distinction between systematic phonetics and physical phonetics is ignored. As soon as we move away from the recorded physical sounds we confront the fact that there is "room for much discussion as to what is the actual character of the universal phonetic theory" (Chomsky 1964:92). Since the theory 'dictates' as it were the nature of phonetic representations, there is also room for discussion in this area.

There is general agreement on the aims of universal phonetic theory which is to describe "the speech sounds that occur in the languages of the world. We want to know what these sounds are, how they fall into patterns, and how they change in different circumstances" (Ladefoged 1975). To accomplish this goal it is proposed that the theory include a "universal phonetic alphabet and a system of laws [the primitive elements of which] are phonetic features each of which can be thought of as a scale in terms of which two or more values can be distinguished" (Chomsky 1972) since "each of the segments in a word can be described as being the sum of a number of components or features" (Ladefoged 1975). The character of the laws it is suggested will "govern the permitted sequences and permitted variety of selection in a particular language". The features selected must reveal the ability of speakers to both produce and understand utterances if the universal theory is to "represent the phonetic capabilities of man" (Chomsky and Halle 1968:295). Furthermore, it must distinguish between "all [the] grammatically determined facts about the production and perception . . . embodied in the 'phonetic transcription'" and the facts "applied by universal rules". In the discussion below, the nature of these universal rules will be discussed.

Much of the work in experimental linguistics at present is concerned with discovering these rules.

There is of course continued discussion on just what features should be included in the theory and what the correlates of these features are. We are concerned with features which will not only help us classify sets of sounds into intersecting sets which form 'natural classes' in phonological systems, but which may also reveal why certain rules occur more frequently in languages, in fact why certain rules exist at all, and which help to explain language acquisition and historical change. This concern has led to continued changes in the sets of features and their correlates.

The earliest descriptions of speech sounds were based on articulatory features, as is evidenced by the IPA chart using the traditional features like 'alveolar', 'stop', 'nasal', 'fricative', etc. A break with the earlier tradition occurred with the publication of *Preliminaries to Speech Analysis* (1952) and *Fundamentals of Language* (1956) where the features are described primarily in acoustic terms. It will be recalled that Jakobson and Halle (1956) singled out the auditory experience as "the only aspect of the encoded message actually shared by the sender and the receiver . . . Since articulation is to acoustic phenomenon as means to effect, the classification of motor data must be made with reference to acoustic patterns" (1956:34-5). Lotz took issue with this view: Since every member of a speech community can act as both speaker and as listener . . . [he] thus experiences the entire speech process . . . [It is possible] that the brain singles out one of the phases, e.g. articulation, and refers the other phases to this kinaesthetic phase" (1950:712). This is essentially the position adopted by Haskins Laboratories in their position that "the relation between phoneme and articulation is more nearly one-to-one than is the relation between phoneme and acoustic signal. . . when articulation and sound wave go separate ways. . . the perception always goes with articulation" (Liberman et al. 1962:7-8). This position echoes that of Paget in 1923: ". . . on identifying . . . particular consonant sounds, and probably in identifying all speech sounds, the ear is primarily concerned in recognizing where and how the closure (or release) is made in the vocal cavity, rather than in identifying the actual resonance changes themselves".

Proponents of an articulatory set of features are found in different theoretical 'camps'. Martinet (1964) believed that "articulatory or motor phonetics gives us a clearer insight into the causality of phonetic changes [than] the sound waves produced by the action of these organs"; Lindblom (1965) suggested that "the acoustico-phonetic experimentation has demonstrated that the neat and simple organization of data at the acoustic level cannot be achieved unless we turn our attention to the preceding stages".

Chomsky and Halle (1968) provide a list of features with their articulatory correlates. While they state that the acoustical and perceptual correlates are not to be considered "as either less interesting or less important", one may infer (perhaps incorrectly) that the lack of any acoustically based features rests on the assumption that all features can be articulatory in nature.

At a first glance the 'substantive' properties of the features may seem unimportant since the segments which constitute a combination of selected features are 'abstractions' from the physical data as are the features themselves. In addition, any phonetic transcription, no matter of what kind, can (or should) be mappable onto (but not identical with) both vocal tract configurations and the sounds which these tract states produce. It is in this sense that Ladefoged et al. (1972) state that "it is inappropriate to speak of a dichotomy between auditory and articulatory theories. At the sensory-motor level of the cortex, which is where phonetic units are encoded for the production of speech, both articulatory and auditory images are available". But it is just because the features play a role in sound patterns, rules, historical change, etc. that the features selected must be those extractable by the child learning a language, thus constituting the descriptive apparatus for phonetic representations.

On the most elementary level only those aspects of the physical signal which we can perceive and only differences in sound which we can produce can be candidates for features. These human physiological and perceptual capabilities are necessary but not sufficient constraints on feature systems. There are aspects of production and perception which may be universal but which nonetheless do not constitute grammatical facts. They may of course interact with the linguistic system when we utilize our linguistic knowledge (the internalized grammar) in speaking and understanding utterances. They may in fact provide some, but not all of the information as to why human languages are as they are. These 'extra-linguistic' mechanisms may also help explain changes in the phonological and phonetic systems of a particular language at two different points in time. But the way in which we control our vocal organs to produce sounds and the perceptual processes by which we perceive sounds are not identical with the kinds of representations of utterances which are abstracted for linguistic purposes. As pointed out by Fodor, Bever and Garrett "a very complex coding system mediates between the internal representation and the speech event . . . The problem of the perceptual analysis of speech is thus the problem of how the speaker recovers the appropriate internal representation of a given acoustic form (i.e. the representation intended by the utterer of the sentence) and the problem of the behavioral integration of speech is the problem of how the speaker, given that he has a certain internal representation of a sentence in mind, maps that representation onto the appropriate acoustic array" (1974:21). A universal phonetic theory must determine what an 'internal representation' (i.e. a phonetic representation) can be.

If the features provided by the universal theory are the wrong set of features (in that they include features which cannot be extracted for linguistic purposes, or do not include features which are so extracted) the phonetic representations included in grammars will be invalid.

Note that this set of linguistic features is not identical with the distinctions which the vocal tract can produce or the distinctions which the ear can perceive. Psycho-acoustic experiments for example have shown that the human ear can perceive and identify many more pitch distinctions than are used in tonal contrasts in languages in the world.

The view of a phonetic representation is in this sense equated with the linguistic *intentions* of a speaker, another way of stating that it is what a speaker 'takes to be the phonetic properties of an utterance'. This view has concerned a number of phoneticians. But surely only such a view can account for the 'cocktail party phenomenon' in which speakers 'hear' aspects of the signal masked by noise, or the phonemic restoration effect

(Warren 1970) in which subjects in a controlled experiment 'hear' phonetic segments physically cut out of the signal. Surely when we talk with a pencil in our mouths our phonetic 'intentions' are identical with those when such an impediment is not present.

This separation between phonetic representations and actual mechanisms used in speech production and perception does not solve the problem of determining what the grammatically determined facts are.

It is generally agreed that the features by which sounds are described should permit the grouping of these sounds into the "'natural' classes that are relevant to the formulation of phonological processes in the most varied languages . . . if a theory of language failed to provide a mechanism for making distinctions between more or less natural classes of segments, this failure would be sufficient reason for rejecting the theory as being incapable of attaining the level of explanatory adequacy" (Chomsky and Halle 1968:335). Campbell (1974), Vennemann (1972), and Vennemann and Ladefoged (1973) show that the Chomsky and Halle features fail in this regard. Campbell presents strong evidence for a feature 'labial' by means of which bilabial and labio-dental consonants can be grouped with rounded vowels to account for the synchronic and historical facts. It is reported that Halle has been convinced of the need for such a feature (Stephen Anderson, personal communication). In addition to the natural class requirement Anderson (1971) has suggested that the feature Labial is also required to distinguish between, for example, labio-dental consonants such as [v] and labial-dental consonants such as [pt].

In Ladefoged's (1975) proposed set of features, Labial is used to distinguish 'doubly articulated' stops like [kp] from velar stops like [k]. [kp] is specified for the prime features 'place' and 'labial' by the values 'velar' and '+', respectively, whereas [k] would be given a '−' value for the prime feature Labial. He further points out the need to distinguish between 'Labial' and 'Round' in that Round "specifies the horizontal distance between the corners of the lips, whereas Labial specifies the vertical distance between the centers of the lips" (1975:266). The independence of these features is also supported by Anderson (personal communication) to distinguish between Swedish 'super-rounded' from 'rounded' vowels [y] and [ʉ]) and in the phonetic specificity of Japanese labial unrounded vowels.

The proposal to include this feature was primarily dictated by phonological requirements. Without such a feature we are unable to provide for the necessary natural classes nor to provide adequate phonetic comparisons across languages.

For similar reasons Hyman (1972), Campbell (1974) and Ladefoged

(1975) propose that the feature Grave which was included in the earlier feature sets (Jakobson, Fant and Halle 1952, Jakobson and Halle 1956) and 'discarded' by Chomsky and Halle in SPE be 'resurrected'. The SPE set of features aims at including just those features which describe "independently controllable aspects of the speech event" (1968:297). The production of the back vowels and of labial and velar/uvular consonants are clearly not the result of the same articulatory gestures. But here is where "some sound patterns . . . are more easily explicable by reference to acoustic rather than to articulatory data" (Ladefoged 1972). The facts of synchronic phonologies as well as historical changes seem to necessitate the feature Grave which can only be due to acoustic properties shared by articulatorily diverse sounds.

Hyman (1972) shows that in FeʔFeʔ reduplication requires a back vowel in the reduplicated syllable just in case the preceding consonant is either a velar or a labial. Similarly in Akan, the vowel in the reduplicated syllable is a high vowel agreeing in 'tenseness' and 'rounding' with the stem vowel. Where, however, the stem vowel is /a/ and the initial consonant is a labial or velar (Grave) one may optionally get a high back vowel, e.g. [pιpa] or [pɷpa] 'remove', [bιba] or [bɷba] 'come', [fιfa] or [fɷfa] 'take', [kιka] or [kɷka] 'bite', but only [sιsã] and never *[sɷsã] 'tie up'. (It should be noted that /h/ also must be considered a Grave consonant in that it similarly conditions an optional back vowel in the reduplicated syllable, e.g. [hιha] or [hɷha] 'trouble').

There is no difficulty in stating these synchronic rules without the feature Grave, as shown in (1):

(1)
$$V \rightarrow [+\text{back}] \,/\, \begin{bmatrix} -\text{vocalic} \\ -\text{coronal} \end{bmatrix} \underline{\qquad}$$

What is suspect, if we are indeed trying to determine the features available to the language learner in the construction of phonological rules, is the disjunction of the classes of [+back] vowels and [−coronal] consonants. The rule appears to be as ad hoc as a rule such as:

(2)
$$V \rightarrow [+\text{round}] \,/\, \begin{bmatrix} -\text{vocalic} \\ -\text{coronal} \end{bmatrix} \underline{\qquad}$$

Feature counting does not help since rule (1) is as 'simple' as rule (3):

(3)
$$V \rightarrow [+\text{grave}] \,/\, \begin{bmatrix} -\text{vocalic} \\ +\text{grave} \end{bmatrix} \quad \underline{\qquad}$$

The change from the Old English velar fricative [x] to Modern English labiodental [f] also appears random and unexplainable without their specification as [−Grave] consonants. As Ladefoged (1975:265) points out: "There is no articulatory reason why this change [as shown in (4)] should have occurred".

(4)
$$\begin{array}{ccc} \text{x} & & \text{f} \\ \begin{bmatrix}+\text{high}\\+\text{back}\\-\text{anterior}\\-\text{strident}\end{bmatrix} & \rightarrow & \begin{bmatrix}-\text{high}\\-\text{back}\\+\text{anterior}\\+\text{strident}\end{bmatrix}\end{array}$$

Despite the 'redundancy' of the gravity value it appears that this feature (predictable from the combination of other features) played a major role in the sound change which occurred. It must then, in some sense, have been 'available' to the speaker-hearers.

But the 'availability' of acoustic information does not necessitate that this information be incorporated in the phonetic representation of utterances. It must however be stipulated by 'universal rule', which rules will then provide explanations for why (2) or the sound change of (4) are 'natural' rather than idiosyncratic. Given that (1) sufficiently accounts for the alternation of vowels, and it certainly does in the case of FeʔFeʔ and Akan, one need not expect rules themselves, by their very form, to 'explain' why they exist, if the Universal Phonetic Theory is rich enough to account for such rules and such changes, to, in other words, make explicit that rule (1) is to be expected just because it is equivalent to (3).

This would require a set of 'cover features' such as are proposed by Vennemann and Ladefoged (1973) and redundancy rules in the phonetic theory. But the theory should stipulate that these 'cover features' are not candidates for distinctive classificatory features. That is, such features, like GRAVE, are the result of physiological and acoustic (auditory) mechanisms which are available to speakers in the actual encoding and decoding of speech. They are properties which may, and indeed do, interact with linguistic properties to facilitate speech production and perception and cause sound changes. This does not make them any less important, but it makes them different in kind from the properties or features which are incorporated in phonetic transcriptions.

As further explanations for synchronic rules and historical changes are sought we will no doubt discover other such 'redundant' features which must be included in the Universal Phonetic Theory but which are not features whose values must be specified in phonetic representations. Note that if one accepts the notion that a phonetic representation is what a speaker 'intends' to produce, the distinction between these two classes of features becomes clearer. It is counter-intuitive to suggest that a speaker 'intends' to produce a grave consonant. That the labials and velars and back vowels which he does intend to produce result in acoustic signals with heightened acoustic energy in the lower frequencies is predictable given the proper universal rules.

The construction of such phonetic 'laws' and 'implicational rules' also relates to the question of whether the same phonetic segment type need always have the same phonetic representation. Anderson (1976) argues convincingly that the Chomsky and Halle system which permits "two distinct ways of representing what may perfectly well be the same phonetic segment type" is correct. His discussion concerns doubly articulated sounds with both labial and velar component, and he points out that "in some instances . . . it is the labial component which is primary, while in others it is the velar; that is, there is phonological ambiguity inherent in such segments". The facts are straightforward and clearly support his conclusion "that in cases of multiple articulations it makes sense to speak of one of the constrictions as primary even where two are of the same degree". It might be suggested that while this may be true on the lexical level, at the phonetic level to permit cross language comparison and phonetic specificity two identical phonetic types must be specified as identical. If however the speaker-hearer internally represents such a phonetic segment in two different ways, this should also be revealed in the phonetic representation. And it presents no problem as long as there is a 'law' in the Universal Phonetic Theory which equates them.

Again we have an example of how the requirements of the Universal Phonetic Theory are dictated by the phonological systems of languages. But it is also hopefully clear that in order to provide explanation for phonetic processes in synchronic grammars and sound changes the phonetic theory must provide such explanatory 'laws' as well as features. It is indeed of interest to the phonetician (and to the general linguist), as Ohala (1974:251) has stated, to understand "how the instructions for the pronunciation of words are stored in the speaker's brain, how these instructions are activated, how the movements of the speech organs are controlled, how these movements produce sound, the effect of sounds on the peripheral auditory system, and the subsequent levels of decoding of the auditory signal in the brain until the listener can associate the signal with some word (or other unit) in his own lexical storage". But such information reveals the ways in which the speaker-hearer encodes and decodes phonetic representations; it does not tell us what the phonetic representation is. Ohala, utilizing articulatory and acoustic information, provides interesting explanations for a number of sound changes that have occurred. In certain cases he suggests that we do not have explanations: "The question still arises: how *were* these OHG vowels lowered? The safest answer at present is 'who knows?'" (1974:267). His attempts to find answers to such questions show the importance of phonetic research to understanding phonological changes. But our lack of explanations for certain sound changes has not, nor should it, prevent us from providing a phonetic representation for the OHG vowels or their present reflexes.

Ohala, however, rejects the concept of a phonetic feature matrix "which is little more than a *list* of the relevant properties of sounds", since he suggests such a representation fails "to show how these properties may interact". He would therefore like considerably more detail in phonetic representations, possibly incorporating all the aspects of the motor system and acoustic properties he lists as given above. But this is to equate phonetic description (description of the abstracted phonetic properties) with phonetic explanation. As Anderson (1974:293) has pointed out: "The features and the processes . . . have a sort of autonomous reality which must be reflected in descriptions. Explaining *why* a language has such and such a property, and not such and such another property, is in principle distinct from the business of describing just what properties it has, and the two projects must be kept separate". I might add, separate, but equal. He goes on to say that "One must start from the description and search for an explanation, rather than attempting to make the explanation shape the description".

There is of course no way to search for an explanation without first having some description to start with.

Much of the present experimental research is concerned with finding explanations for phonetic facts, synchronic and historical. Lindau's (1975) recent work, for example, suggests an explanation for the merging of /ι/ and /ɷ/ with /e/ and /o/ respectively in certain Kwa languages. In articulatory terms, the high vowels belong to the vowel harmony set which she demonstrates as being characterized by a narrow pharynx, whereas the second two vowels are in the opposing vowel harmony set characterized by an expanded pharynx. In these languages prior to the merger the non-low vowels in the two harmony sets were as follows:

Narrow pharynx		*Expanded pharynx*	
ι	ɷ	i	u
ɛ	ɔ	e	o

The question then was why the merger should have involved the high vowel of one set with the mid vowel of the other. The articulatory facts alone can not account for this. But Lindau shows that "Varying the size of the pharynx, as between /i/ and /ι/, and /e/ and /ɛ/ affects F1 (the first formant): that is it has the same general acoustic effect as varying the size of a constriction in the front of the mouth. Decreasing the pharynx size (by retracting the tongue root) increases F1 in the same way as opening up a constriction of the mouth does (by lowering the body of the tongue). That is, going from [ι] to [e] by mainly increasing the size of the mouth constriction, and going from [i] to [ι] by decreasing the pharyngal size will have very much the same acoustic effect. This is clearly shown by the acoustic merging of /ι/ and /e/" (1975:20). She provides a much more detailed explanation which "involves predictions from a theory that is developed independently from theories of vowel production, namely acoustic perturbation theory" (1975:122), a theory first put forth by Ohman (1973). The details of perturbation theory go beyond the scope of this paper, but what is clear from Lindau's work is that the kinds of phonetic research which she conducted provides explanations for changes which have occurred, including the fact that in some dialects of Akan, for example, the front vowels have merged whereas the back vowels have remained distinct. While perturbation theory accounts for the merger of the front vowels it cannot account for the merger of the back vowels [ɷ] and [o] in these languages where this occurred. Lindau suggests that this is due to 'linguistic pressure' rather than acoustic pressure: "once /ι/ and /e/ overlap acoustically, this will create a structural pressure towards making the system symmetric again by merging the corresponding back vowels. It is a fact that Niger-Congo vowel systems with harmony have a strong tendency towards symmetry". This illustrates the fact that all changes can not be given a physiological and/or acoustic explanation. Linguistic and extra-linguistic factors interact. But there are times when the extra-linguistic factors are the only ones which can explain phonetic phenomena. Lindau refers to Williamson (1975) who discusses Proto-Lower-Niger languages. Williamson states that in these languages the front vowels merge unconditionally, but the back vowels only merge when conditioned by following nasal consonants, because, Lindau points out, the "extra nasal poles and the associated zeroes would tend to increase the perceptual similarity between the vowels". A phonetic description of the change which occurs can only refer to the phonetic properties of these segments, not the perceptual effects of nasal poles. That is, the change can be described by the rule:

(5)

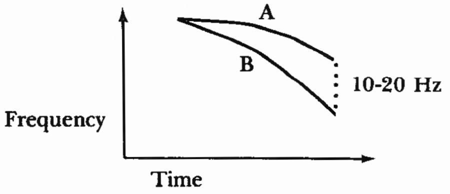
$$\overset{\text{V}}{\begin{bmatrix}+\text{high}\\-\text{expanded}\end{bmatrix}} \rightarrow \begin{bmatrix}-\text{high}\\+\text{expanded}\end{bmatrix} \;/\; \underset{<+\text{back}>}{\underline{\qquad\qquad}} \left\langle\begin{matrix}\text{C}\\+\text{nasal}\end{matrix}\right\rangle$$

To try to incorporate features showing the acoustic interaction of these sounds is to describe why the change occurred, not what change occurred.

In the discussion of the feature Grave above it was indicated that properties of sounds which are predictable by universal rule, which cannot be used to distinguish between phonological or phonetic distinctions, need not be specified in phonetic representations. Take for example the relative length distinction of vowels before voiced and voiceless consonants. As pointed out by Chen (1970) and others the extent of the distinction is not predictable in English, although in all languages there is some small difference. (See Fromkin 1973, 1975). If vowel length were not specified in phonetic representations in English, it would be impossible to compare the phonetics of English with other languages where for example there is a distinctive length contrast with the contrastively long vowels identical to the predictably long vowels in English. Yet can one maintain that the speaker of English 'intends' to produce a longer vowel before [b] than before [p]? This must be the case, in parallel with the intention to produce a /p/ as [p^{h}] or [p] in certain phonetic contexts. Thus 'intention' does not mean 'conscious' intention, anymore than a rule of syntax implies conscious knowledge of the rule. The phonetic distinctions are predictable by the grammar but not determined by universal rules; therefore such information is required for phonetic speficiability and cross-language comparison.

The situation becomes more complex when we try to determine the properties of the signal which are 'used' by speakers to distinguish between phones. In a pilot study conducted by Louis Goldstein at UCLA, he found that when presented with two stimuli, identical except for the pitch perturbations preceding final stop consonants, subjects predictably identified the stimulus with the lowered pitch as ending with a voiceless consonant. That is, the subject 'heard' either *cap* or *cab* when only the fundamental frequency slope and value differed. The different stimuli are schematized in (6).

(6)



A perceived as *cap*

B perceived as *cab*

No data are available regarding the use of this perceptual cue in other languages. It is clear, however, that such information is available for speakers and can be used, and in fact, may be used in normal as well as 'noisy' situations in the mapping of the signal onto the phonetic, linguistic representation.

Clearly the intention of the speaker is to produce a final voiced or voiceless stop and not to produce different fundamental frequency slopes. That this is the result of the articulation permits its use as an acoustic cue in the decoding of the speech signal. Again this fact must be made explicit in the general theory and need not be specified in the phonetic transcriptions of *cap* and *cab*.

The development of tonal contrasts resulting from initial consonant types is widely attested; (Haudricourt 1961, Matisoff 1973, Hombert 1974, 1975). Recent experimental work conducted by Hombert (1975) also provides an explanation for the development of contour tones resulting from the loss of final [h] and [ʔ]. He cites numerous cases attested in the literature on sound change which reveal the disappearance of final glottal stops with the consequential development of rising tones (e.g. Vietnamese, Burmese, Middle Chinese and others). Similarly there are cases where falling tones have replaced final [h] as in Middle Chinese and Vietnamese. In his search for an explanation of this tonogenesis Hombert first analyzed six C_1VC_2 nonsense words spoken by four Arabic speakers in a sentential frame with C_1 = [m], V = *i, a, u* and C_2 = *h,* ʔ. He found that "[h] produces a drop in Fo (varying from 25 to 50 Hz) on the preceding vowel while [ʔ] produces a rise in Fo (from 9 to 48 Hz)", and that "these two curves become significantly different at least 70 ms before vowel offset". He followed his analysis with a perceptual experiment and showed "that F1 perturbations similar to those caused by [h] and [ʔ] can be perceived even when these perturbations are very small ($\Delta f = \pm 10$ Hz and $\Delta t = 40$ ms)".

He further suggests that such experimental data argue against a speculative claim that in Slavic a postvocalic [h] gave rise to a high tone. Hombert's experimental work not only provides an explanation for attested sound changes but invalidates a proposed unattested change.

Such experimental research, and many others which could be cited, are providing us with a greater understanding of how the physiological and perceptual apparatus interact with and influence phonetic systems. They do not invalidate the more traditional concepts of phonetic representations. It is unnecessary to include any 'pitch perturbation' features in a phonetic representation as long as the Universal Phonetic Theory includes 'interpretive' or 'implicational' rules which clarify the relationship between consonant types and pitch, place of articulation features and 'gravity' etc.

This does not mean that 'the last word' is in on the features which should be included for specification of phonetic representations. As is shown by Lindau's work, experimental research is providing new evidence for the correlates of features and, in fact, new features which will provide more valid phonetic transcriptions.

In this paper I have attempted to provide further evidence in support of Ohala's (1975:289-316) assertion "that in order to gain some understanding of the shape or of the patterning of speech sounds, including the direction of their change over the years, one must examine how the human articulatory and perceptual systems operate". I further agree with him that phonologists, seeking explanations for certain phenomena cannot "ignore . . . or explicitly deny . . . the relevance of anatomical, physiological, or acoustic-auditory aspects of speech", nor do I believe that phoneticians can ignore or deny the relevance of the phonological and phonetic facts of human language for it is these facts that we attempting to explain.

Anderson, S.R. 1971. "On the description of 'apicalized' consonants". *Linguistic Inquiry* 2.103-106.

Anderson, S.R. 1974. *The Organization of Phonology.* New York.

Anderson, S.R. 1976. "On the description of multiply-articulated consonants". *Journal of Phonetics* 4 (in press).

Bach, E. and R.T. Harms (edd.). 1968. *Universals in Linguistic Theory.* New York.

Bloomfield, L. 1926. "A set of postulates for the science of language". *Language* 2.153-164.

Bloomfield, L. 1933. *Language.* New York.

Campbell, L. 1974. "Phonological features: problems and proposals". *Language* 50.52-65.

Chen, M. 1970. "Vowel length variation as a function of the voicing of the consonant environment". *Project on Linguistic Analysis* No. 9. Phonology Laboratory, University of California, Berkeley.

Chomsky, N. 1964. "Current issues in linguistic theory". *The Structure of Language*, edd. J.A. Fodor and J.J Katz, 50-118. Englewood Cliffs, N.J.

Chomsky, N. and M. Halle, 1968. *The Sound Pattern of English.* New York.

Chomsky, N. 1972. *Language and Mind.* New York.

Fillmore, C.J. 1968. "The case for case". *Universals in Linguistic Theory*, edd. E. Bach and R.T. Harms, 1-90. New York.

Firth, J.R. 1957. *Papers in Linguistics 1934-1951.* London.

Fischer-Jørgensen, E. 1964. "The phonetic basis for identification of phonemic elements". *Journal of the Acoustical Society of America* 24,6.611-617.

Fodor, J.A., T.G. Bever and M.F. Garrett. 1974. *The Psychology of Language.* New York.

Fromkin, V. 1972. "Discussion paper on speech physiology". *Speech and Cortical Functioning*, ed. J. Gilbert. New York.

Fromkin, V. 1975. "The interface between phonetics and phonology". Paper presented at the Eighth International Congress of Phonetic Sciences, Leeds.

Greenberg, J.H. (ed.) 1963. *Universals of Language.* Cambridge, Mass.

Haudricourt, A.G. 1954. "De l'origine des tons en vietnamien". *Journal Asiatique* 242.69-82.

Haudricourt, A.G. 1961. "Bipartition et tripartition des systèmes de tons dans quelques langages d'extrême-orient". *Bulletin de la Société de Linguistique de Paris* 56.163-180.

Hjelmslev, L. 1947. "Structural analysis of language". *Studia Linguistica.* 1.69-78.

Hombert, J.M. 1974. "Production and perception: their respective roles in one case of tonal development". Paper presented at the Annual Meeting of the Linguistic Society of America, New York.

Hombert, J.M. 1975. "Development of tone from segmentals: evidence from contour tone perception". Paper presented at the Eighth International Congress of Phonetic Sciences, Leeds, England. To appear in *Proceedings.*

Hooper, J.B. 1975. "The archi-segment in natural generative phonology". *Language* 51.536-560.

Jakobson, R., G. Fant and M. Halle. 1952. *Preliminaries to Speech Analysis.* Cambridge, Mass.

Jakobson, R. and M. Halle. 1956. *Fundamentals of Language.* The Hague.

Joos, M. 1957. *Readings in Linguistics.* Washington, D.C.

Ladefoged, P. 1971. *Preliminaries to Linguistic Phonetics.* Chicago.

Ladefoged, P., J. DeClerk, M. Lindau and C. Papcun. 1972. "An auditory-motor theory of speech production". *Working Papers in Phonetics* (University of California, Los Angeles) 22.48-75.

Ladefoged, P. 1975. *A Course in Phonetics.* New York.

Leben, W.R. and O.W. Robinson, Jr. 1975. "Upside-down phonology". Paper read at the Annual Meeting of the Linguistic Society of America, San Francisco.

Liberman, A.M., F.S. Cooper, I.S. Harris and P.R. Macneilage. 1962. "A motor theory of speech perception". *Proceedings of Speech Communication Seminar.* Royal Institute of Technology. Stockholm.

Lindau, M. 1975. "[Features] for vowels". *Working Papers in Phonetics* (University of California, Los Angeles) 30.

Lindblom, B. 1963. "Spectrographic study of vowel reduction". *Journal of the Acoustical Society of America* 35.1773-1781.

Lotz, J. 1950. "Speech and language". *Journal of the Acoustical Society of America* 22,6.712-730.

Martinet, A. 1964. *Elements of General Linguistics,* transl. E. Palmer. Chicago.

Matisoff, J. 1973. "Tonogenesis in Southeast Asia". *Consonant Types and Tone*, ed. L. Hyman, 71-96. University of Southern California.

Ohala, J. 1974. "Phonetic explanation in phonology". *Papers from the Parasession on Natural Phonology*, edd. A. Bruck, R.A. Fox and M.A. La Galy, 251-274. Chicago.

Ohala, J. 1975. "Phonetic explanations for nasal sound patterns". *Nasalfest: Papers from a Symposium on Nasals and Nasalization*, edd. C.A. Ferguson, L.M. Hyman and J. Ohala. Language Universals Project, Stanford University.

Ohman, S. 1973. [untitled manuscript]. University of California, Los Angeles.

Paget, R.A.S. 1923. "The production of artificial vowel sounds". *Royal Society Proceedings* A102.752-765.

Sapir, E. 1925. "Sound patterns in language". *Language* 1.37-51.

de Saussure, F. 1960. *Course in General Linguistics*, transl. Wade Baskin. London.

Trubetzkoy, N.S. 1969. *Principles of Phonology*, transl. C.A.M.Baltaxe. Los Angeles, Berkeley.

Vennemann, T. 1971. "Natural generative phonology". Paper read at the Annual Meeting of the Linguistic Soceity of America, St. Louis.

Vennemann, T. 1972. "Phonological uniqueness in natural generative grammar". *Glossa* 6.105-116.

Vennemann, T. and P. Ladefoged. 1973. "Phonetic features and phonological features". *Lingua* 32.61-74.

Warren, R.M. 1970. "Perceptual restoration of missing sound". *Science* 167.392-393.

Phonotactics and the Syllable

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In his paper of 1962 "Is the vowel-consonant dichotomy universal?", Joseph Greenberg gives a re-appraisal of two notions:

I. The viability of distributionally-defined phoneme-classes and syllables,
II. The nature and status of syllables in Bella Coola.

He raises some interesting issues which after fourteen years are worth a further look against a background of recent phonological thought. It will be convenient, as well as flattering in the sincerest manner, to recognise two analogous divisions in the present paper, though, as with Greenberg's two notions, there is an evident logical link between them.

1. The definition of the syllable

We may note, and endorse, Greenberg's overriding conclusion that "the phonetic notion [of vowel, consonant, and syllable] remains in a sense primary since the criterion for a successful phonologic [i.e. distributional] definition is reasonable conformity with the phonetic facts" (1962:73). Indeed, distributional 'definitions' of phonological elements (including vowel, consonant, and syllable) usually turn out not so much to DETERMINE the actual nature of these entities as to REFLECT it. In other words, they are COROLLARIES rather than DEFINITIONS of those elements. Things called 'syllables', for instance, occur in languages, not because there is any virtue in one arrangement of elements rather than another, but precisely because of certain aspects of phonetic reality.[1]

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[1] This does not contradict the position adopted in my earlier article (Fudge 1969). In the functioning of a grammar the LOGICAL STATUS of syllables is that they are "postulated as elements of the abstract calculus in terms of which the underlying system may be described" (1969:256) and only then characterized in terms of observable phenomena. The EXPLANATION of why such an element has to be postulated in every grammar is that certain physical constraints operate on the spoken aspect of human language, and one set of these (to be discussed later in this section of our paper) determines that speech is organized into syllables. Expounding the logical status of syllables is not the same thing as explaining them.

I have argued elsewhere (Fudge 1973:173-4) that 'phonetic' is not a single notion, and is therefore not precise enough for the discussion of facts of 'sound' of any sort; a fortiori, it is hardly likely to provide a good basis for pinpointing the raison d'être of the syllable. A further subdivision of 'phonetic' into (a) acoustic, (b) perceptual, and (c) articulatory is necessary, though not sufficient, for the investigation of this question. We will consider the relevant factors under these three heads.

(a) Acoustic causes for the fairly regular alternation of certain sound-types can fairly clearly be ruled out: there is no acoustic reason why all conceivable sequences of sound-waves should not occur with equal frequency. It should be noted that, although 'sonority' is an acoustic property, definitions of the syllable in terms of sonority in fact rest on the tendency for 'spontaneous voicing' to occur in conjunction with certain articulatory configurations; such definitions will therefore be discussed under (c) below.

(b) The satisfactory perception of stops depends to a large extent on the presence of transitions to neighbouring sonorants; to this extent the nature of syllables[2] tends toward assisting rather than hindering perception. However, this is not the same as saying that this is the underlying cause of the importance of syllables in language.

(c) Our three-way division is notably insufficient in the articulatory sphere. Various scholars have suggested as the basis of the syllable such differing notions as 'chest pulses' (Stetson 1928, followed by Pike 1943), 'puffs of air' (Rosetti 1963), 'peaks of prominence' (Jones 1956), 'peaks of sonority' (Hála 1961), while de Saussure (1916) based the syllable on his distinction between the 'explosive' and the 'implosive' phases of the activity of the oral tract — that is to say, he took the raison d'être of the syllable as being the way in which, during speech, jaw, tongue, and lips alternate continually between less open and more open positions: long sequences of sounds of the same degree of opening tend to be avoided. In order to show that this last theory is a more valid statement of the essence of the syllable than any of its rivals, we may argue as follows:

(i) If there are puffs of air, they are caused by chest pulses, or perhaps by the combination of chest pulses and the opening-closing movements of the vocal tract. This rules out Rosetti's definition.

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[2] If 'stop' and 'vocoid' (diametrically opposed types of articulation) are the 'archetypal' sound classes (as is indicated by a study of language acquisition in children, or by the general tendencies of frequencies of sound classes in various languages), then the archetypal syllable might be taken as having the form 'stop + vocoid' or 'stop + vocoid + stop'. Significantly (in view of the argument of this section), the resonance of the transition from stop to vocoid or from vocoid to stop is determined by the configurations adopted by the vocal tract as it opens or closes.

(ii) If there are chest pulses, they occur as a RESULT of, or perhaps as PRE-PLANNING for, the air-flow variations needed as the openings and closings of the vocal tract take place. The movement of the lung walls, after all, is constant or smoothly varying during normal breathing when no speech is being produced: more complex motions are needed in speech precisely because the shape of the vocal tract is undergoing constant modification. Thus Stetson's theory too is a derivative one, not a truly defining one.

(iii) If there are peaks of sonority, they occur when voicing and relative openness co-occur.[3] But voicing occurs spontaneously (i.e. more naturally than its absence) in conjunction with what we may term sonorant articulations (Chomsky and Halle 1968:302); these are characterized by openness of one kind or another in the upper vocal tract. Thus again it is the opening and closing of the oral tract that is presupposed by its rival hypothesis.

Hála, it is true, argues specifically against de Saussure: "De Saussure lui-même avoue que, du point de vue phonétique, son procédé n'est pas acceptable; on peut l'admettre uniquement, dit-il, en ce qui concerne l'explication de la nature de la syllabe. Mais, la syllabe ne serait-elle donc pas un élément phonétique?" (1961:77). Once again the term 'phonétique' should switch on the warning lights and cause us to analyse further: the fact is that Hála appears to use it in two quite different senses here. In the rhetorical question he is using the word in an extremely general, all-embracing sense, whereas in the first sentence he appears to mean something much more specific, namely that the 'openness' theory of the syllable cannot guarantee a correct answer to every possible question involving syllabification in each and every language. It does not, for example, provide a full set of 'watertight' language-independent rules governing placement of syllable-boundaries; it does not even provide a method of unambiguously determining the exact number of syllables in any stretch of speech in any language.

For instance, initial preconsonantal /s/ and final postconsonantal /s/ in English (cf. *stops*) do not form separate syllables although they are more open than the neighbouring plosives. But then none of the other views of the syllable do any better: the monosyllabic *stops* embraces not only three maxima of openness, but three puffs of air; the 'chest pulse' theory is complicated by cases where two syllables may be produced by the same chest pulse (Pike 1943:54); the 'sonority' theory works for English *stops* but fails with languages like Japanese (Mori 1929:68-71) or Moroccan Arabic (Harrell 1962) in which voiceless vowels may regularly operate as syllable nuclei.

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[3] Hála distinguishes, quite legitimately, between 'sonority' and 'noisiness' – the consonant *s*, he says, "n'est pas sonore, elle est 'pénétrante', 'mordante'" (1961:75).

Finally, of course, whatever theory we take will not account for those very frequently occurring cases where speakers of different languages consistently discern different numbers of syllables in one and the same acoustic configuration (Japanese speakers tend to hear three or even four syllables in *stops*). These cases demand a distinction between (a) the raison d'être of the syllable (which clearly must be language-independent) and (b) the precise definition of the syllable of a particular language (which equally clearly is likely to vary from language to language). I have tried to draw such a distinction in this paper, and would maintain that de Saussure did the same. If such a distinction is valid, then it is illogical to follow Hála in rejecting de Saussure's notion of (a) on the grounds that it does not fit (b).

2. Phonotactics and the syllable in Bella Coola (and some other languages)

"There are no syllables in Bella Coola", says Newman categorically (1947:132); "there are no characteristics of phoneme grouping that require or that can be stated in terms of a structurally significant unit such as the syllable, . . . The phonetic structure of the language can only be described in terms of the sequences of phonemes, word junctures, and word groups separated by pause". (1947:133). On the other hand, the various kinds of acoustic and articulatory phenomena which one would normally take as concomitant features of the syllable DO occur:

> Within a sequence of phonemes one can, of course, hear acoustic pulsations and even differences in the relative degree of pulsation. Such phonetic syllables result partly from the acoustic nature of the phonemes themselves. Because of their fortis articulation, glottalized stops and affricatives are pronounced with stronger pulsations than their non-glottalized types. Vowels and syllabic continuants, because of their duration and voicing, stand out acoustically above all other phonemes in a sequence. When two or more syllabics occur in a word or sentence, one can clearly hear different degrees of articulatory force. But these relative stresses in a sequence of acoustic syllables do not remain constant in repetitions of the utterance. (1947:132).

But surely Bella Coola is no different from any other language in these respects: to take Newman's last point first, not only is it the case that stress does not correlate in a one-to-one manner with articulatory force (it may be physically realized by increased duration or by pitch features of various kinds), but also stress is essentially potential in nature — there are certain positions in most languages in which a syllable known to be the accented syllable of the word in fact manifests none of the physical attributes associated with stress. In English, for example, words which occur after the intonation nucleus or before the intonational head often have no physical marking of their accented syllable (Kingdon 1958:160-66). Thus few languages, if any, will allow the analyst to deduce the position of accented syllables uniquely and unambiguously from the presence of the physical parameters realizing stress.

On the other hand, just as with the syllable (see section 1 above), we cannot rule out the possibility that the raison d'être of stress is connected with the physical parameters which tend to realize it on a good proportion of occasions in most languages, namely extra duration, pitch prominence, and greater intensity.[4] But once again, we must note that the phonological definition of stress in a particular language is not the same thing as the raison d'être of stress in languages in general. To argue, with Newman, that stress is not a relevant category in Bella Coola because "stresses . . . do not remain constant in repetitions of the utterance" (1947:132) is tantamount to espousing the converse of Hála's argument (see the final paragraph of section 1), i.e. that (b) must be rejected on the grounds that it does not fit (a): a position which is just as untenable as Hála's. In other words, the variability of the intensity of syllabic peaks in Bella Coola cannot be taken as implying that stress is not a relevant phonological category in that language.

Even if it is argued that the number of syllables does not remain constant from one repetition of an utterance to another in Bella Coola, this still does not set it off from other languages, as Newman claims. English *cement* may be pronounced on different occasions as [sɪˈmɛnt] or [s̩ˈmɛnt], or even as [ˈsmɛnt] (rhythmically indistinguishable from [ˈsmɛlt] *smelt*).

The reason for Newman's refusal to recognise the syllable as phonologically relevant in Bella Coola (see quotation from p. 133 in the first paragraph above) is not given as part of the argumentation; it is merely stated in the summary of the section. It has to do with "the almost unlimited toleration of the language for consonant clusters" (1947:132). Two things need to be said: firstly, as we shall see below, the difficulty in recognizing patterns in the consonant clusters is due in large measure precisely to Newman's rejection of the syllable. Secondly, the statement of consonant distribution is only one possible use of the syllable (a use which will be trivial in languages where only CVCVCV. . . sequences occur): it is also the principal factor in the statement of the normal rhythm of a language. We would have no inkling of how to set about saying a large number of the Bella Coola words which Newman cites as examples if he had not given subphonemic details of pronunciation (1947:129-31) — details which among other things make it clear where syllabic peaks come, e.g. 'phonemic' /k^{w}ttmci/ (diminutive of 'husband') is pronounced[5] [k^{u}TəTəmTSi] with three or perhaps four syllables (1947:131).

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[4] Could this raison d'être perhaps be that the semantic category of emphasis (a universal category, and partly, at least, an extra-linguistic one) has gestural concomitants which in turn give rise to these stress features? In the present state of development of language, these gestural concomitants have become 'institutionalized'; part of this 'institutionalization' would be that (with regularity which may vary somewhat from language to language) the stress tends to be placed on the same syllable of the word in all its occurrences.

The question whether Newman is justified in eliminating these vowels and vocalic off-glides from his phonemic transcription is intimately connected with the question whether phonotactics is 'interpretive' or 'generative' (Matthews 1972:221-3). In other words, does phonotactics take strings of phonemic segments and insert syllable- and word-boundaries into these, or should words, syllables, and other 'larger' phonological elements be taken as logically prior to phonemes and features? The former position, interpretive phonotactics, at first sight offers the simpler theory (for example, the relations between syntax, morphophonemics, and phonotactics would be relatively simply stated), and it is therefore important to consider whether there are properties of natural language in general, or of particular languages, which require the apparatus provided by generative phonotactics. In fact Bella Coola and typologically similar languages cast a good deal of light on this question.

First we may note that the strict interpretive phonotactician comes up against special problems in languages where a considerable proportion of syllable nuclei, phonetically speaking, are sonorant contoids: even in English, where normally syllabic contoids occur only in unstressed syllables, difficulties arise. Thus if the word *present*, phonetically [ˈpɹɛzn̩t], is phonemicized as /preznt/, then a final consonant cluster /-znt/ has to be handled by the phonotactics (with the /n/ predictably syllabic by an allophonic rule), or else /n̩/ has to be recognized as a syllabic peak, in other words as a vowel in its own right. This would mean that, while the vowel system in stressed English syllables is /ɪ e æ . . . i: eɪ aɪ . . . /, the vowel system in unstressed syllables is /ɪ ə l̩ m̩ n̩ (and ɹ̩ in some varieties)/. Both of these conclusions are disturbing, and no scholars seem to embrace either of these analyses: the reasons for this are not far to seek.

Firstly, morphophonemic parallelism works against the latter conclusion. Morphophonemically the /n/ is parallel to a sequence of /Vn/: /prɪˈzent/ (verb) v. /ˈprezn̩t/ (noun), /sens/ v. its opposite /ˈnonsn̩s/ (syllabic /l/ behaves similarly: /menˈtælɪtɪ/ v. /ˈmentl̩/). Secondly, phonologically the [n̩] is parallel to a sequence [ən]: [ˈprɛzn̩t] v. [ˈpɛnənt]; for some words, indeed, the pronunciation with [n̩] and that with [ən] both occur: the word *competent* is pronounced sometimes as [ˈkɒmpɪtn̩t] and sometimes as [ˈkɒmpɪtənt].

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[5] Superscript ^{u} and ^{i} represent voiceless vocalic transitions of approximately [u] and [i] quality. Letters representing occlusives, when capitalized, represent voiceless unaspirated sounds; otherwise, they represent voiceless aspirated sounds.

It thus accords much better with the structure of English to treat all instances of [n̩] as if they were [ən], so that, for example, the /n/ of /ˈpreznt/ belongs to the coda of its syllable rather than constituting its peak; this would then be phonemicized as /ˈprezənt/. This enables the analyst to avoid having to deal with extra codas like /znt/: in /ˈprezənt/ the /z/ acts as onset to the second syllable rather than part of the coda of the one and only syllable, which makes this word phonotactically parallel to /prɪˈzent/ (a desirable result in view of the relatedness of the two words).

Apparently there are languages where the reverse holds, i.e. where most instances of [n̩] etc. are most naturally treated as if they were [nə] etc.: Moroccan Arabic seems to be one such, according to Harrell (1962:646-7). English is quite clearly not of this type: [n̩] and [l̩] are only very sporadically and unsystematically paralleled by [nə] and [lə]; thus *denseness* and *pamphlet* cannot be pronounced as [ˈdɛnsn̩s] and [ˈpæɱfl̩t].

Newman's account appears to indicate that Bella Coola is like English rather than Moroccan Arabic on this point: "The syllabic continuant is preceded by a brief vowel of variable quality" (1947:130). However, he adopts the converse procedure for phonemicizing this — the vowel is neglected as predictable, and so is the syllabicity of the continuant: [nəmnəmk'ⁱ] is phonemicized as /nmnmk'/ (1947:130). We can straightaway see how this procedure leads to the multiplication of formidable consonant sequences that cannot be accounted for by any normal 'cluster' scheme. Newman's error is that he has adopted a strict interpretive phonotactics; in other words he works according to the following scheme:

(1) Establish a phonetic representation.
(2) Remove all predictable details (including ALL MENTION of a consonant or a vowel when both its position and its quality are predictable from the immediate context).
(3) All considerations of phonotactics must be strictly excluded until stage (2) has been completed.

It should be noted that it is precisely such a scheme which leads to the first undesirable alternative mentioned above in connection with the English noun *present*: the second undesirable alternative arises when (a) the strict exclusions of stage (3) are relaxed to the extent that the strictly predictable syllabicity of the [n] is still marked in the transcription when the phonotactics gets to work, and (b) stage (1) is constrained by the requirement that only features DIRECTLY OBSERVED in the speech signal are allowed to form part of the phonetic respresentation (so that the phonetic representation of the noun *present* cannot contain [ə], in spite of the phonological and morphophonemic indications that it should).

A step in the right direction would be to postulate that, wherever a phonetic vowel is removed under stage (2) as completely predictable, some mark is left at that place in the phonetic sequence where it occurred; this would mean that the vowel in question was regarded as a 'zero' from the point of view of vowel quality, though not from the point of view of the sequence of segments. Thus Bella Coola [nəmnəmk'$^{\text{i}}$] 'animal' would be phonemicized as /n*mn*mk'/ or perhaps as /n*mn*mk'*/, where * marks the place of the predictable vowels. Two advantages accrue from this: firstly, the pronunciation is determined as being [nəmnəmk'$^{\text{i}}$] rather than, say, [nmənmək'$^{\text{i}}$] (though admittedly it would be possible to frame a general principle for the language to handle this); secondly, we see that syllable structure in Bella Coola is considerably simpler than we feared,[6] and that consonant clusters promise to yield to an analysis of the normal kind after all.

What, it may be asked, do we gain from phonemicizing with * (a kind of zero), rather than with ə (a vowel on a par with other vowels)? Thus (to continue with our same Bella Coola example) in what way are the phonemicizations /n*mn*mk'/ or /n*mn*mk'*/ better than /nəmnəmk'/or /nəmnəmk'ə/? The answer appears to be that morphophonemically a zero fits in better than a positive quantity in a number of cases. For example, the two ways of saying 'I made him strong' in Bella Coola are shown in (4) and (5) (cf. Newman 1969a:175);[7]

(4)	(morphophonemic)	tam	+	tł	+	its
		causative		strong		I . . . him
	(phonotactic)	tam.tłits				
(5)	(morphophonemic)	tł	+	tuts		
		strong		causative I . . . him		
	(phonotactic)	t*ł.tuts				

Sometimes, then, the root meaning 'strong' appears phonotactically in a non-syllabic form, sonetimes in a syllabic form, though in both cases the sequence of segments realizing it is /tł/. If a full vowel were postulated in

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[6] In fact the structure we would set up for Bella Coola syllables would be the most important part of the general principle for sorting out pronunciation.

[7] In the phonotactic representations, the dot '.' is used to mark syllable boundaries. In the phonotactic representation of (5) and in Table I, I have adopted Greenberg's excellent suggestion (1962:72-80) and treated the fricatives ("frictional continuants" — and surely "frictionless" three lines from the bottom of p. 79 is a misprint?) as potentially syllabic; I have then extended to these sounds Newman's treatment of syllabic sonorants (1947:130) as being parallel to a sequence of [ə] + consonant.

(5), morphophonemic variation would arise (/tł/ v. /təł/), necessitating either a vowel insertion rule or a vowel deletion rule; such rules not only complicate a grammar, but handle business which ought to be handled elsewhere (in the phonotactics). Further examples of how Bella Coola words (cf. Newman 1947, 1969a, 1969b) respond to this treatment are found in Table I.

TABLE I

EXAMPLES ILLUSTRATING THE APPLICATION OF THE ASTERISK NOTATION TO BELLA COOLA WORDS

Morphophonemic	Meaning	Phonotactic
1. k'x + its see I....it	'I see it'	k'xits (or k'*.xits ??)
2. k'x + tap see they....you	'They see you'	k'*x.tap
3. łx̣^{w}t + m + ix^{w} go through transi-tivizer you....it	'You went through it'	ł*x̣^{w}t.mix^{w}
4. łx̣^{w}t + m + tix^{w} you....them	'You went through them'	ł*x̣^{w}.t*m.tix^{w}
5. sk'lx + lx + ts cold become I	'I'm getting cold'	sk'*l.x*lxts (or sk'*l.x*l.x*ts ?)
6. ts'kt + s + k^{w} + ts' arrive he quota-tive perf-ective	'He arrived'	ts'*.k*t.sk^{w}*ts'
7. łx̣^{w}t + ł + ts go through ? I	'I went through'	ł*x̣^{w}.t*łts

The principles underlying this kind of analysis are seen at work even more clearly in Abaza. This and closely related languages of the Caucasus are typologically similar to Bella Coola in the following respects:[8]

(i) The phonological vowel inventory is small.

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[8] Two more similarities could be noted, about whose relevance to the point at issue one might speculate:

(iv) Palatalization and labialization occur as distinctive secondary articulations on non-anterior consonants. The small vowel inventory (point (i) in the text) means that offglides and onglides have a wide range of vowel qualities available, so that little or no extra 'perceptual cost' is involved in the distinctive use of these features.

(v) Ejectives are an integral part of the sound system. The change in the airstream mechanism typically provides this kind of sound with a very clear vocalic transition.

(ii) The base forms of many morphemes (both roots and affixes) consist purely of a consonant or a sequence of consonants; thus many long and apparently unstructured consonant sequences occur in words of the language.

(iii) Phonetically these consonant sequences are broken up by vocalic transitions of predictable quality occurring in predictable positions.

Abaza has a two-vowel system in stressed syllables, characterizable in terms of relatively open v. relatively close (Allen 1956:129, 1965:117). In other types of syllable even a two-term system seems excessive:

> In other positions one does in fact notice similar vocalic articulations to those of the main-stressed syllable — viz. open and close. But in the case of the close articulations it is found that their *presence or absence* (and not simply their quality) is there determined by their consonantal environment; so that they may be considered simply as vocalic transitions between two consonantal articulations. Once the conditions for these transitions have been stated, there is no case for setting up a 'close' vowel term in such positions. (Allen 1956:141-2 — italics in the original).

This approach is consistent with strict interpretive phonotactics as expounded above. However, Allen recognizes that for these predictable vowels lack of DISTINCTIVE VALUE does not imply total lack of LINGUISTIC IMPORTANCE: "close vocalic articulations in other than the main stressed syllable are to be treated as prosodic ('anaptyctic') and not as phonematic" (1956:142).

The conditions governing the transitions are said to be very complex:

> The most widely applicable is the 'two-consonant rule', which must however be understood as subject to restriction by other conflicting rules (concerned in particular with the semi-vocalic, liquid and nasal articulations); the rule is statable as follows:
>
> 'Counting the consonantal articulations back from the end of the complex [= 'word' approximately], or from any vocalic articulation bearing main or secondary stress, there is a secondarily stressed vocalic transition between the second and third consonantal articulations'. (1956:142).[9]

Thus the complex meaning 'They couldn't shift him', morphologically analyzable as (6), is pronounced as (7) and can be phonotactically analysed as (8) (cf. Allen 1956:142 — notation changed to conform with that so far used in the present paper). Likewise ‘He could not make them give it back to her’ is morphologically (9), phonetically (10), and phonotactically (11) (Allen 1956:139, 170).

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[9] The complexities besetting the two-consonant rule indicate quite clearly that the real purpose of these conditions is to specify permitted and preferred syllabic structures. The two-consonant rule itself specifies the preferred structure of CVC, with perhaps CVCC in word-final position, while the 'conflicting rules', with their particular reference to semivowels, liquids, and nasals, deal with permitted clusters within the syllable, which typically involve these sound types. The final definition of 'weak cluster' in Chomsky and Halle (1968:83) has precisely analogous complications.

(6)	d	+	g^y	+	d	+	z	+	m	+	r	+	əts’s	+	d
	him				they		can				caus-ative		move		past
			negative												

(7) [diġidzɪmˈrɪts’ɪsd][10]

(8) d*.g^y*d.z*m.rə́.ts’*sd

(9)	y	+	g^y	+	y	+	z	+	d	+	m	+	l	+	r	+
	it				he		can		they				her		caus-ative	
			negative													
	ətx	+	d													
	give back		past													

(10) [jiġi:zdɪml̩ˈrɪt$^{h(ə)}$xd]

(11) y*.g^y*yz.d*.m*l.rə́.t*xd

In a later work, Allen (1965:117-8) argues for the elimination of /ə/ in stressed syllables also. His conclusions are thus very similar to those of Kuipers (1960) regarding the (related) Kabardian language; Kuipers claims, among other things, that:

(a) post-tonic instances of [ə] can be predicted as occurring between consonantal segments and non-syllabic sonorants (cf. 1960:41),

(b) tonic [ə] is also predictable: “In the stressed syllable itself the absence of *a* implies the presence of *ə*” (1960:42).

Halle (1970:100-01) criticizes the arguments by which these conclusions were reached. Post-tonic [ə], he points out, is predictable only if we know where stress falls, but at the same time the stress rule operates correctly only if we know where [ə] has been inserted: “In other words, in order to dispense with the symbol *ə* in the representations, Kuipers has to introduce the symbol ʹ. Thus, his first step amounts to no more than a trade-off of one symbol and one rule for a different symbol and a different rule.” (1970:100). It is not clear to me whether rules can be formulated for the placement of stress in Abaza: certainly the place of stress is distinctive in a ‘taxonomic phonemic’ sense — /ála/ ‘the eye’ v. /alá/ ‘the dog' (Allen 1965:118).[11] However, for Kabardian Halle's observation is certainly correct — Kuipers cannot be said to have gained anything by his treatment of post-tonic [ə].

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[10] The symbol [ġ] is used for palatalized [g].

On the other hand, it seems to me that neither Kuipers nor Halle are on firm ground in their treatment of tonic [ə]. Kuipers writes stressed /a/ as *´a*, in other words, the stress phoneme FOLLOWED BY the vowel phoneme /a/; then in the sequence *´ə* (representing stressed /ə/) the *ə* is redundant — hence [ə] is predictable in the stressed syllable. Halle is right in his observation that "Kuipers treats ´ as a segment (phoneme), rather than as a feature of a segment" (1970:100), and also in his rejection of this treatment. But the remainder of Halle's argument (1970:101) is not so well founded; firstly, his contention that in such cases the choice of which vowel to make predictable is an arbitrary one, and secondly, his assumption that Allen's position is in this respect identical to Kuipers's.

On the first of these points, it is worth quoting at length:

> Kuipers, therefore, declares the *ə* redundant in the environment after ´, and claims thereby to have shown that *ə* is predictable in stressed syllable. But this is an empty notational trick. By the same argument one can show that in English /ō/ as in *hole* is redundant in the environment after /h/. It is a well-known fact that /h/ can appear only prevocalically. Thus when /h/ appears in a phonemic representation of English we know for sure that the next segment must be a vowel. We are now free to choose which vowel to make predictable. Since it is a totally arbitrary matter which vowel is to be made predictable, it is also utterly without interest. It shows that there is something wrong with the principles underlying the analysis, but tells us nothing about English. And the same is true of Kuipers' analysis; it cannot be taken, therefore, as a demonstration that *´ə* is not a vowel in Kabardian. (1970:101).

In this instance the choice of /ō/ rather than any other vowel would indeed be an arbitrary matter; however, if in some language there were pressing morphophonemic reasons justifying the choice of /ō/ (if, say, /ō/ was always introduced between a morpheme ending in /h/ and one beginning with a consonant), this choice would emphatically not be arbitrary. Now this is precisely the situation which holds in Kabardian and Abaza: morphophonemically, representations WITHOUT /ə/ (and even without stressed /ə/) make far more sense than representations INCLUDING /ə/:

> If the [Abaza] word /an/ 'mother' is prefixed by the possessive pronouns meaning 'my', 'your (f.)', 'your (m.)', 'his', the resulting forms are /san/, /ban/, /wan/, /yan/ respectively; if the word /pa/ 'son' is set in the same contexts, the results are, phonetically [spa], [bəpá], [wupá], [jipá]; if [ə], [u] and [i] were here given

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[11] Consideration of the accentual properties of the various morphemes (Garde 1967, 1968) might, of course, lead to the formulation of satisfactory rules: in stating the Kabardian stress rule, Kuipers himself makes mention of stress-neutral affixes (1960:34).

> phonemic status, they would, quite apart from being phonologically inadmissible on any reckoning, present evident and unjustifiable incongruities in morphophonology. (Allen 1965:122).

To spell Allen's argument out in full, we are faced here with two alternatives:

(i) The possessives have the underlying forms /s/, /b/, /w/, /y/, and there is a rule introducing [ə] into certain consonant sequences;

(ii) The possessives have the underlying forms /s/, /bə/, /wə/, /yə/, and there is a rule deleting /ə/ before a vowel.

Of these two solutions, (i) is the more satisfactory: as shown by Allen (1956:142 — cf. the quotation given above), the rules introducing [ə] into consonant sequences are extremely general, whereas a vowel deletion rule is motivated only by the need to delete instances of /ə/ which need not have been in the underlying representation to begin with. The logical conclusion of alternative (ii) is in fact that we are forced to recognize the form represented in (9), (10), and (11) above as having eleven syllables: "If . . . one considers any consonant (in view of its transitions in some environments) as the potential carrier of an 'inherent vowel', the form in question is a *hendecasyllable*." (Allen 1956:170).

Turning to our second point, Halle assumes that Allen's conclusions about the status of [ə] rest on arguments which are identical with those of Kuipers: "W.S. Allen bases his case for regarding Abaza . . . as having only one vowel on THE SAME NOTATIONAL MISUSE [as Kuipers]" (1970:101 fn. 3 — my emphasis). He picks out in particular Allen's use (1965:118) of the phrase "the incidence of stress (where absence of /a/ automatically implies *ə*)". Halle does not appear to notice that Allen nowhere adopts Kuipers's expedient of denoting a stressed vowel by a sequence of two segments: representations like *´a* just do not occur in Allen's work, and hence it cannot be said that he treats stress "as a segment rather than as a feature of a segment". The analogy between Abaza /'/ and English /h/ does not hold in Allen's argument, which may be paraphrased: "Only vowels can occur with the feature [+stress]; there are only two distinct stressed vowels; one of these is something of an embarrassment in the morphophonemics; therefore we will mark the other vowel, but leave this one unmarked, to be predicted from the place of stress".

But Allen writes the form meaning 'he hit her' as /dl ´sd/ (1965:120) where earlier he had written it *dlə́sd* (1956:154), and by the same token he would write (6) and (9) above as (12) and (13) respectively:

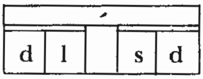
(12) dg^{y}dzmrʼts'sd

(13) yg^{y}yzdmlrʼtxd

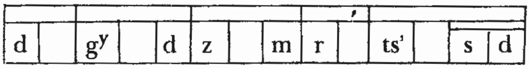
We might ask whether in so doing he is not using the notation in exactly the same way as Kuipers. By /dl ʹsd/ Kuipers would mean a sequence of five phonemes, of which the third is /ʹ/, which in turn predicts the insertion of an epenthetic [ə] between it and the fourth phoneme, making six segments in all.[12] In Allen's notation, however, /dl ʹsd/ means approximately "a sequence of four phonemes separated by a stressed something-or-other which turns out to be [ə]". This situation also is problematic, but for a different reason from the analogous situation for Kuipers: Allen's problem is whether the feature of stress can in fact operate as an 'unsupported' element — is a 'stressed zero' possible?

In order to see that Allen's problem is somewhat less intractable than Kuipers's, we must first note that Halle is not correct in stating that stress is a feature of a segment (1970:100) — it should be regarded as, in essence, a feature of the syllable.[13] It is extremely difficult to relate a sequential treatment of stress of the Kuipers type to any syllable-based theory. On the other hand Allen's 'unsupported' stresses may easily enough be interpreted as being associated with syllables whose peak is occupied by a non-distinctive element (thus it is not the 'zero' that is stressed, but the non-zero syllable containing it). This, of course, is precisely the implication of our asterisk notation. Thus /dl ʹsd/ would be a 'shorthand' for the representation given in (14), while (12) and (13) would imply the fuller representations given in (15) and (16).

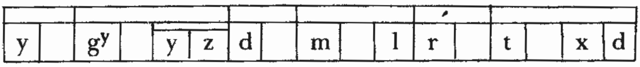
(14) Syllable
Segments



(15) Syllables
Segments



(16) Syllables
Segments



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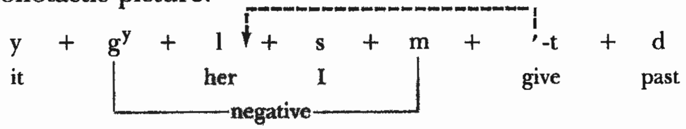
[12] At the level of phonetic realization, ʹ and ə are presumably held to coalesce into one segment, stressed [ə].

[13] Stress is a feature of the syllable since there is only one stress per syllable as a general rule: even in those languages where the mora has to be recognized in calculating the place of stress, it is often the case that the stress is actually borne by the syllable. In languages like Ancient Greek where it is in fact the mora that bears stress, the mora is to be defined as a part of the syllable, not in terms of any particular segments in the syllable. Again, to assign stress to vowel segments makes the operation of stress rules more complex: what ought to be a single rule, or a small set of rules is greatly complicated by the recurrence of the expression 'C_0', which multiplies both the number of subrules and the amount of computation needed to determine whether the rule applies. For other arguments in favour of stress assignment to syllables see McCawley (1974:61-2), and also Sampson (1970:603).

The use of ‘unsupported’ stress by Allen in giving the basic form of morphemes (e.g. /ʃ$^{y\prime}$/ ‘kill’, / ’-s/ ‘hit’, / ’-t/ ‘give’ (1965:120)) is rather different in implication — in this case it is a ‘shorthand’ for a statement of the accentual properties of the morphemes (Garde 1967, 1968). Thus /ʃ$^{y\prime}$/ is post-stressed and / ’-s/ and / ’-t/ pre-stressed in Garde’s terms — interestingly Allen (1965:120 fn. 36) uses just this latter term in speaking of them.

The crucial issue for Allen is whether the place of stress (or rather, the place at which the peak of the stressed syllable has to be introduced into the string of consonants) can be completely predicted on the basis of such accentual properties — if not, then for at least some instances of stressed [ə], the place of the vowel will need to be marked in base forms. He appears to imply that rules can be given: for instance: “In ‘pre-stressed’ roots . . . the stress may be discontinuous with the consonant if certain categories of uniconsonantal element precede” (1965:120 fn. 36). The illustration he gives is the form meaning ‘I didn’t give it to her’ — morphophonemically this can be represented as in (17), while (18) gives the phonotactic picture:

(17)



(18) y*g^{y}.l$\acute{*}$.s*m.t*d

However, on the basis of the details given by Allen it is not clear whether such rules can be framed to handle all cases.

A third example of a language in which syllables without peaks occur is, by Harrell’s account (1962), Moroccan Arabic. Harrell follows our treatment of transitions between consonants rather than Newman’s: he phonemicizes them as /ə/ rather than eliminating them entirely, at the same time treating syllables containing them as being “syllables without centers” (1962:646). Thus the word for ‘I saw you’, phonemicized as /šəftək/ (1962:645) is equivalent in our notation to š*f.t*k (cf. item 1 in Table II). Syllabic contoids are, as stated earlier, treated as contoid + ə (cf. item 2 of Table II); long syllabic contoids (Harrell exemplifies with the phonetic form of 3) appear to lend themselves to three different treatments, 3(a), (b), and (c), all consistent with Harrell’s principle (though 3(a) yields a rather forced phonotactic analysis, with an initial cluster /tll/ which is decidedly odd), and also to two more, 3(d) and (e), not consistent with Harrell’s principle but nevertheless yielding plausible phonotactic analyses. A three-term distinction of length is shown by contoids, including obstruent contoids; Harrell proposes to treat the extra-long contoids as two identical consonants separated by /ə/, as indicated by the remaining items in Table II.

TABLE II

EXAMPLES ILLUSTRATING THE APPLICATION
OF THE ASTERISK NOTATION TO MOROCCAN ARABIC
DATA FROM HARRELL 1962

Phonetic form	Meaning	Phonological (Harrell)	Phonotactic (Fudge)
1. šftk	‘I saw you’	šəftək	š*f.t*k
2. tl̩t	‘three’	tlət	tl*t
3. tl̩·to	‘they multiplied by three’	(a) tllәto	(tll*.to)
		(b) tlәlto	tl*l.to
		(c) tlәlәto	tl*.l*.to
		(d) (tәllto)	t*ll.to
		(e) (tәlәlto)	t*.l*l.to
4. səmha	‘her name’	səmha	s*m.ha
5. səm·ha	‘her poison’	səmmha	s*mm.ha
6. səm:ha	‘he poisoned her’	səməmha	s*.m*m.ha
7. xəf·o	‘they hurried’	xəffo	x*f.fo
8. xəf:o	‘he made it light’	xəfəfo	x*.f*.fo
9. ḥka	‘he related’	ḥka	ḥka
10. ḥək·o	‘he rubbed him’	ḥəkko	ḥ*k.ko
11. ḥək:um	‘he rubbed you (pl.)’	ḥəkəkum	ḥ*.k*.kum

What are the implications of the asterisk notation for the question of interpretive v. generative phonotactics? Looking back to our characterization of strict interpretive phonotactics ((1)-(3) above), the asterisk notation means that stage (3) must be begun BEFORE stage (2) is completed; if we allow this, then we have at least MOVED IN THE DIRECTION of generative phonotactics. Remembering, too, that leaving the syllabicity of the [n] of /preznt/ marked in the representation is not of itself sufficient to rescue us from the second undesirable solution (i.e. that [n] may function as a full vowel in unstressed syllables of English), we may conclude that the requirement that all features of phonetic and phonemic representations be directly observable in the speech signal is also too strict. In other words, the syllabic organization of certain stretches of speech in a language should be carried out, not on the basis of inherent features of those stretches, but by analogy with other stretches; thus the final part of /preznt/ is syllabified by analogy with the final part of /prɪˈzent/, resulting in the phonotactic representation ˈpre.z*nt.[14]

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[14] This raises the possibility that some instances of * in English may be introduced by phonological rule; for example, the underlying form of both words *present* could be /pre+zent/, with the vowel reduction rule taking the form ‘unstressed vowel → *’ rather than ‘unstressed vowel → ə’. For some dialects of English, of course, this is complicated by the fact that two distinct qualities of reduced vowel ([ɪ] v. [ə]) occur in some contexts.

But the asterisk notation does not represent merely a move in the direction of generative phonotactics, it presupposes a THOROUGHGOING generative phonotactics. It operates as a 'place-holder' to prevent consonants from being allocated to the wrong part of the syllable, or to the wrong syllable, and thus has intimate connections with the 'morph-loading' rules proposed by Fudge (1972:146-7). These rules presuppose a PREVIOUSLY SPECIFIED syllabic structure into which strings of consonants and vowels (output of the morphophonemics) are fitted; in other words, they are part and parcel of a generative phonotactics. The advantages which accrue to the use of the asterisk notation (clearer specification of the way words are to relate to syllables; simpler statement of phoneme distribution) are thus to be attributed to the greater power of generative phonotactics. More important, they also show that this greater power is NEEDED by a linguistic model. We conclude, therefore, that, in spite of the seeming greater simplicity of interpretive phonotactics, it is in fact generative phonotactics that is to be preferred.

Allen,W.S. 1956. "Structure and system in the Abaza verbal complex". *Transactions of the Philological Society* 127-76.
Allen, W.S. 1965. "On one-vowel systems". *Lingua* 13.111-24.
Chomsky, N. and M. Halle. 1968. *The Sound Pattern of English.* New York.
Fudge, E.C. 1969. "Syllables". *Journal of Linguistics* 5.253-86.
Fudge, E.C. 1972. Review of P. Postal, *Aspects of Phonological Theory. Journal of Linguistics* 8.136-55.
Fudge, E.C. 1973. *Phonology.* Penguin Modern Linguistics Readings. Harmondsworth, Middx.
Garde, P. 1967. "Principes de description synchronique des faits d'accent". *Phonologie der Gegenwart*, ed. J. Hamm, 32-45. Graz. (English version: Fudge 1973.309-19).
Garde, P. 1968. *L'accent.* Paris.
Greenberg, J. 1962. "Is the vowel-consonant dichotomy universal?". *Word* 18.73-81.
Hála, B. 1961. "La syllabe: sa nature, son origine et ses transformations". *Orbis* 10.69-143.
Halle, M. 1970. "Is Kabardian a vowel-less language?". *Foundations of Language* 6.95-103.
Harrell, R.S. 1962. "Consonant, vowel and syllable in Moroccan Arabic". *Proceedings of the Fourth International Congress of Phonetic Sciences* 643-7. The Hague.
Jones, D. 1956. *An Outline of English Phonetics.* (ed. 8). Cambridge.
Kingdon, R.P. 1958. *The Groundwork of English Intonation.* London.
Kuipers, A.H. 1960. *Phoneme and Morpheme in Kabardian.* The Hague.
Matthews, P. 1972. *Inflectional Morphology.* London.
McCawley, J.D. 1974. Review of Chomsky and Halle 1968. *International Journal of American Linguistics* 40.
Mori, M.G. 1929. *The Pronunciation of Japanese.* Tokyo.

Newman, S. 1947. "Bella Coola I: phonology". *International Journal of American Linguistics* 13.129-134.

Newman, S. 1969a. "Bella Coola grammatical processes and form classes". *International Journal of American Linguistics* 35.175-79.

Newman, S. 1969b. "Bella Coola paradigms". *International Journal of American Linguistics* 35.299-306.

Pike, K.L. 1943. *Phonetics*. Ann Arbor.

Rosetti, A. 1963. *La syllabe.* (ed. 2). The Hague.

Sampson, G. 1970. "On the need for a phonological base". *Language* 46.586-626.

de Saussure, F. 1916. *Cours de linguistique générale.* Paris.

Stetson, R.H. 1928. *Motor Phonetics.* Archives néerlandaises de phonétique expérimentale 3. The Hague.

Linguistic Typology and Indo-European Reconstruction

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The latter half of the 20th century has been marked in the history of linguistics by an enhanced interest in problems of diachronic studies, this being a return to the treatment of problems which arose in the classical, comparative Indo-European linguistics. This growing concern with problems of diachronic linguistics stems from the general development of linguistic thought over the past decades. Overcoming the Saussurean antinomy between synchronic and diachronic linguistics, it is striving to build a linguistic theory that would have more explanatory power in comparison to the purely synchronic theories of taxonomic grammar built strictly on the basis of empiric linguistic data.

The ultimate aim of diachronic linguistics is the reconstruction of early linguistic states with a view to elucidating the ways of the origin and development of historically attested related language systems. Such a reconstruction of the parent-language state is attained by a comparison of historically attested cognate language systems and by a retrospective movement from one state to another, earlier state, until the language state is reached from which all the historically attested cognate language systems can be deduced under an assumption of a definite set of structural transformations. Such transformations lead us from the original (basic) language system to later language states which are the result of its structural changes.

Structural transformations postulated in this way may be described as 'vertical' or diachronic (in contrast to 'horizontal' transformations generating new constructions within the same system). With the help of these transformations various related language systems are deduced from theoretically postulated basic structural patterns. By their explanatory power in respect to the language structure the vertical or diachronic transformations, deducing historically attested forms of a language from certain theoretical constructs considered to be chronologically earlier stages of these forms (their archetypes), are comparable to horizontal transformations of the transformational-generative grammar which deduce the observable surface-structure constructions of a language from theoretically postulated basic constructions constituting the deep structure of the language.

The problems of modern diachronic linguistics are closely linked with the problems and methods of language typology and the linguistics of language universals — one of the main branches of modern linguistic science.

One of the basic tasks of present-day linguistics is to establish a structural isomorphism of languages, to study general principles underlying language structures. Typological studies are called upon to bring this isomorphism to light, to identify the invariant characteristics of languages and to establish language universals on various levels of language structure. A language universal is conceived of as a rigorously formulated regularity inherent in all languages or at least in most languages, thereby reflecting essential linguistic characteristics. Of particular value in this respect are language universals arrived at inductively as a result of a generalization of the regularities established in respect to a definite set of languages (Greenberg 1966).

Linguistic research has established so far a number of language universals on various levels of language structure, enabling thus a judgment of the invariant characteristics of natural languages.

In particular, at the phonological level in the subsystem of stops certain hierarchic correlations of markedness may be ascertained among the phonemic units of various series and local orders (Pedersen 1951, Greenberg 1970, Melikishvili 1974).

In systems with an opposition of stops on the feature of [voice] the voiced labial phoneme /b/ is a functionally stronger unit than the voiced velar stop /g/. Such a correlation can be established on the basis of a higher relative frequency of the phoneme /b/ in comparison with the velar /g/ in various language systems with an opposition of occlusives on the feature of [voice].

Stated otherwise, the combination of the features 'labiality' and 'voice' is unmarked and opposed to the combination of the features of 'velarity' and 'voice' serving as a marked bundle. Inversely, in the class of voiceless stops (both plain and glottalized) the velar /k/ (and correspondingly /k^{h}/ and /k'/) — being an unmarked member of the opposition — is characterized by a greater functional load than the labial stop /p/ (and correspondingly /p^{h}/ and /p'/) that serves as a marked and accordingly functionally weak member. The relative frequency of a voiced phoneme in the labial series is higher than the frequency of the voiceless, whereas in the velar series the frequency of the voiceless phoneme is higher than the frequency of the voiced.

Thus, ‘velarity’ combined with ‘voicelessness’ and ‘labiality’ combined with ‘voice’ form optimal combinations yielding phonemes /k/ and /b/, whereas combinations of ‘voicelessness’ with ‘labiality’ and of ‘voice’ with ‘velarity’ create functionally weak units /p/ and /g/.

Empty slots (gaps) in the paradigmatic system are distributed according to the established functional correlations of markedness. Systems with gaps in the class of stops, opposed according to voice/voicelessness, assume in general the form in (1-3):

(1)	b	-	(2)	b	p	(3)	b	-
	d	t		d	t		d	t
	g	k		-	k		-	k

The degree of markedness in the class of voiceless stops increases in accordance with the superposition on the bundle of the additional feature of aspiration or glottalization; incidentally, glottalization appears as a feature of a higher degree of markedness than does aspiration, so that the hierarchic sequence of increasing markedness in the class of unvoiced stops has the form: voiceless (plain) ~ aspirated ~ glottalized.

Thus, the glottalized labial /p’/ appears in relation to the aspirated /p^h/ as a marked member of the opposition, whereas the aspirated /p^h/ is marked in relation to the voiceless plain phoneme /p/.

Gaps in the paradigmatic systems are represented in accordance with these correlations. The possible systems with gaps in the respective series of voiceless stops are given in (4) and (5).

(4)	b	p^h	-	(5)	b	-	-
	d	t^h	t’		d	t^h	t’
	g	k^h	k’		g	k^h	k’

Language systems evince a definite hierarchic order among diverse types of structural — in particular, phonological — oppositions, indicating the existence of a strict stratification of phonological values. It should be assumed that it is in conformity with such universally valid correlations that diachronic phonemic transformations occur in a language. A number of diachronic phonemic changes in a system, at first sight appearing as mutually independent and unrelated processes, turn out to be interrelated and interdependent transformations controlled by such an hierarchy of phonological values.

Linguistic typology should be assigned a special place in diachronic linguistics, in reconstructing the common linguistic patterns of historically attested related language systems and in establishing the transformations of the given structures into historical systems. Such a reconstruction of the common language patterns should be effected in full conformity with the general linguistic regularities established in typological linguistics and the theory of language universals. Typological verification of a language system under reconstruction enhances the probability of the postulated phonological and morphological structures which reflect, in the first approximation, the system of the common language (Jakobson 1958).

On the other hand, the reconstructed system of the common language should be characterized by the property of typological deducibility, i.e., it should have transformational characteristics allowing a deduction of the systems of historical languages in full conformity with the evidence of diachronic typology — with patterns of linguistic transformations established on the basis of the historical data of the attested structures. Thus, diachronic verification of a postulated language system constitutes — along with its verification on the basis of the data of synchronic typology — one of the main aspects in assessing the probability criteria of the postulated common language system. Language typology thus proves an indispensable premise of any language reconstruction — of diachronic linguistics in general. This determines the significance and the place of linguistic typology in diachronic, comparative-historical linguistics.

In its current stage of development comparative-historical linguistics is essentially a unitary discipline with typological linguistics and language universals. This leaves a special imprint on the nature of linguistic reconstructions set up in modern diachronic linguistics.

Until recently the typological criteria of the linguistic probability of the postulated original language system has not been consistently taken into account in Indo-European comparative-historical linguistics. Even when the structures under reconstruction were practically postulated in conformity with linguistic probability it was not the result of a conceptualized implementation of a definite methodological principle. Neither was the typological plausibility of the conjectural linguistic transformations of the original system taken much into account. Moreover, in some cases in reconstructions based on internal structural evidence the principle of linguistic probability is thought to be essentially irrelevant to the system under reconstruction.

The lack of explicit methods of typological verification of a postulated system led, in Indo-European comparative linguistics, to the fact that until the most recent past the structural patterns postulated on the basis of comparative and internal reconstruction for the common Indo-European language (Proto-Indo-European), contradicting as they did the evidence of linguistic typology, appeared to be hardly probable from a typological point of view.

This primarily concerns the subsystem of Indo-European stops, traditionally reconstructed as in (6) in the form of three phonemic series: I voiced, II voiced aspirates, and III voiceless.

(6)

I	II	III
(b)	bh	p
d	dh	t
g	gh	k
$g^{u̯}$	$g^{u̯}h$	$k^{u̯}$

It has long since been noted that functional weakness or even complete absence of the labial phoneme *b* in the reconstructed series of voiced stops does not conform to the universally valid typology of stops in which the voiced labial phoneme *b* invariably emerges as a functionally strong, unmarked member of the voiced series of stops characterized by a high frequency of occurrence and freedom of distribution (Pedersen 1951).

The absence of voiceless aspirated stops, in the presence of corresponding voiced aspirates (series II), constitutes another typological incongruity of the traditionally reconstructed system of Indo-European stops (Jakobson 1958).

Bringing such a system of stops into correspondence with the data of linguistic typology — both synchronic and diachronic — necessitates a complete revision of the traditionally reconstructed system of Proto-Indo-European stops and its representation as in (7) in the form of three phonemic series opposed as I glottalized ~ II voiced (aspirates) ~ III voiceless (aspirates), with voiced and voiceless stops occurring positionally in the form of aspirated and corresponding non-aspirated variants (Gamkrelidze and Ivanov 1972; cf. Gamkrelidze and Ivanov 1973).

(7)

I	II	III
(p')	bh/b	ph/p
t'	dh/d	th/t
k'	gh/g	kh/k
$k'^{u̯}$	$g^{u̯}h/g^{u̯}$	$k^{u̯}h/k^{u̯}$

The feature of aspiration in a system of this type is in effect phonologically irrelevant, for the series II and III are opposed not by aspiration but by the feature of voice.

The feature of aspiration in the given series emerges as a concomitant phonetic feature of these phonemes characterizing concrete combinatory manifestations of their allophones.

From a strictly phonological point of view these three series could be defined as glottalized ~ voiced ~ voiceless. However, the phonetic feature of aspiration is an essential feature of the phonemes of the series in question, accounting for their diachronic transformations and ultimate reflexes in historical languages. Phonetic features of phonemes play a special part in diachronic phonemic transformations, and a consideration and description of such features — along with phonologically distinctive features — should become an obligatory principle of diachronic phonology.

Incidentally, it seems to be possible to determine the distributional patterns of allophonic variations of the phonemes of series II and III.

In particular, when phonemes of series II co-occurred in a root, one of the units was realized as an aspirate, the other as a non-aspirate. Thus, e.g., a root morpheme /*b^{h}eu̯d^{h}-/ would be manifested as [*beu̯d^{h}-] or [*b^{h}eu̯d-] according to the paradigmatic alternations of the morpheme. Grassmann's Law should be accordingly interpreted not as a deaspiration rule operating independently in Indo-Iranian and Greek, but as a rule of allophonic variations, still at the Proto-Indo-European level, of the phonemes of series II.

The same assumption could easily, and in a natural way, account for the phenomena described by Bartholomae's Law. A morphemic sequence of /*b^{h}ud^{h}-/ and /*-t^{h}o-/ would be realized as [*bud^{h}-] + [*-t^{h}o-] → [*bud-t^{h}o-] (in accordance with the rule of non-cooccurrence in a sequence, either distant or in contact, of two aspirated allophones), this yielding Old Indian *buddha*, by progressive assimilation on the feature of voice.

Such a system of Common Indo-European stops reconstructed on the basis of a comparison of the phonemic systems of historically attested Indo-European languages with account of the frequency characteristics of universally valid relations of markedness in the phonological system appears to be — unlike the traditionally reconstructed system — in full agreement with both synchronic and diachronic typological evidence. The suggested system appears thus more probable than the traditionally reconstructed system of Indo-European stops.

This interpretation of the three series of Common Indo-European stops affords a natural phonological explanation of the functional weakness of the labial phoneme /p'/ of the glottalized series I in Indo-European, which remained unaccounted for in the traditional theory under the assumption of the feature of voice for series I of Indo-European stops.

Under such an interpretation a number of restrictions imposed on the structure of the Indo-European root is given a natural phonetic-typological interpretation. The absence of roots with voiced stops of the **deg-*, **ged-* type — a fact well known in classical comparative linguistics, but typologically eluding explanation — finds a natural phonetic explanation in the suggested system of Proto-Indo-European stops with the feature of glottalization in series I. In view of their articulatory-acoustic peculiarities glottalized stops do not tend to combine with each other within a root, a phenomenon that may be illustrated on an extensive typological linguistic material (cf. the evidence of Amerindian, African, and Caucasian languages with glottalized consonants).

Furthermore, non-cooccurrence in the IE root of the phonemes of series II and III may be easily interpreted as a rule of the agreement of occlusives in the root on the plus/minus value of the feature of voice: the co-occurring stops must be either [+voiced] or [−voiced].

The proposed reconstruction of the Common Indo-European stops, taking into account both synchronic and diachronic typology, differs considerably from the system of the Proto-Indo-European consonantism as reconstructed in classical comparative linguistics.

In the new interpretation, the Common Indo-European system of stops proves to be closer to the systems traditionally defined as those with Lautverschiebung (Germanic, Armenian, Hittite), whereas systems which were thought to be in respect to consonantism close to the Common Indo-European system (Old Indian, Greek, Italic, etc.) appear to be a result of complex phonemic transformations of the original language system.

In the latter group of languages, the original glottalized phonemes (series I) became voiced (a phonetic process that has a parallel in a number of languages with glottalized consonants). A series of voiced stops thus appears, which is necessarily supplemented by a labial member that was regularly missing (or weakly represented) in the original glottalized series.

The voiced stops originating in this way merge with the non-aspirated allophones of the phonemes of series II, causing its splitting into two phonological series: pure voiced stops and voiced aspirates with corresponding reflexes in historical Indo-European dialects. Thus, the complex transformations of the original system of Indo-European stops in historical Indo-European dialects may be described in terms of the merger and split of the phonological series of Indo-European stops rather than in terms of consonant shifts.

The traditionally established trajectories of the transformation of Indo-European stops into the phonemic units of individual Indo-European languages change accordingly, acquiring — in the new interpretation of the Common Indo-European phonological system — a reverse direction. The basic phonetic laws of the classical comparative linguistics, such as Grimm's Law, Grassmann's Law, Bartholomae's Law, etc., are also conceptualized anew, acquiring a different meaning in the light of the new interpretation of the Indo-European system of stops.

The Indo-European system of stops in such an interpretation appears to be typologically close to the language systems of the historically adjacent areas — Kartvelian and Semitic. This poses new problems as to the interrelationships of these linguistic systems within a common cultural area.

The evidence of modern linguistic typology — both synchronic and diachronic — in effect necessitates a revision of the traditional schemes of the classical comparative linguistics by advancing new comparative-historical reconstructions.

These and a whole range of other relevant linguistic and cultural historical problems pertaining to the new theory are discussed at length in a forthcoming joint monograph by Vjacheslav V. Ivanov and myself dealing with "Indo-European and the Indo-Europeans. A reconstruction and structural typological analysis of the Proto-Indo-European language and the Indo-European culture".

Gamkrelidze, T.V. and V.V. Ivanov. 1972. "Lingvističeskaja tipologija i rekonstrukcija sistemy indoevropejskix smyčnyx". *Konferencija po Sravnitel'no-Istoričeskoj Grammatike Indoevropejskix Jazykov,* Predvaritel'nye Materialy 15-18. Moscow.

Gamkrelidze T.V. and V.V. Ivanov. 1973. "Sprachtypologie und die Rekonstruktion der gemeinindogermanischen Verschlüsse". *Phonetica* 27.150-56.

Greenberg, J.H. 1966. *Language Universals with Special Reference to Feature Hierarchies.* The Hague.

Greenberg, J.H. 1970. "Some generalizations concerning glottalic consonants, especially implosives". *International Journal of American Linguistics* 36,2.

Jakobson, R. 1958. "Typological studies and their contribution to historical comparative linguistics". *Proceedings of the Eighth International Congress of Linguists.* Oslo.

Melikishvili, I. 1974. "K izučeniju ierarxičeskix otnošenij edinic fonologičeskogo urovnja". *Voprosy Jazykoznanija* no. 3.94-105.

Pedersen, H. 1951. *Die gemeinindo-europäischen und die vorindo-europäischen Verschlusslaute.* Det Kongelige Danske Videnskabernes Selskab 32.5. København.

Phonologization*

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In discussions of the relationship between phonetics and phonology, a distinction is sometimes made between 'intrinsic' and 'extrinsic' variations in the speech signal (Wang and Fillmore 1961). By and large these have been viewed in terms of being intended or unintended variations: extrinsic variations are language-specific gestures called into play in a given language, while intrinsic variations are the universal, innocent byproducts of the extrinsic gestures. Thus, to take an example which I shall discuss in some detail, if a speaker wants to distinguish [pa] from [ba], we expect him to adjust the voice onset time of the former to commence with the release of the consonant [p], but to allow voicing to commence in the latter with the initiation of the consonant [b]. In other words, the above established phonetic transcriptions indicate that speakers are controlling the presence vs. absence of vocal cord vibration in the production of these two stops. Voicing is thus an extrinsic feature of this language.

On the other hand, if we were to investigate [pa] and [ba] closely, we would in all likelihood find that the fundamental frequency of [a] begins somewhat higher after [p] than after [b]. For reasons which phoneticians are now debating (see Ohala 1973), voiceless consonants raise the pitch of a following vowel, while voiced consonants lower pitch. This generalization appears to be universal. We are therefore safe in asserting that the pitch characteristics of the vowel [a] in the above examples were probably not 'programmed' separately from the voicing difference between [p] and [b]. Instead, they are the *result* of this difference. It is thus not necessary for a separate command to raise or lower pitch to originate from the brain, for, as John Ohala likes to put it, the vocal tract will do the same job without such a command. The raising and lowering of pitch found respectively after voiceless and voiced consonants is thus an intrinsic feature of this (and presumably all) languages.[1]

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It so happens, however, that what begins as an intrinsic byproduct of something else, predicted by universal phonetic principles, ends up as unpredictable and hence, extrinsic. Thus, in various Southeast Asian languages initial historical **p* and **b* have merged as voiceless, with **b* conditioning lower variants of pre-existing tones (Haudricourt 1961, Matisoff 1973).[2] At some point before the devoicing of **b*, the lower fundamental frequency of the following [a] had to take over the distinctive value of the *p/b* contrast. That is, to continue the above reference to neural commands, a separate message to listen to pitch for pitch's sake had to come into being. The historical process involved is represented in the derivations in Table I.

TABLE I

Stage I	*Stage II*	*Stage III*
pá [—]	pá [—]	pá [—]
bá [⌐—]	bǎ [_/]	pǎ [_/]
'intrinsic'	'extrinsic'	'phonemic'

In Table I we start with two high-toned syllables [pá] and [bá] in order to conform with the attested bifurcation of tones in Southeast Asia (cf. footnote 2).

In stage I the intrinsic pitch-lowering caused by prevocalic voiced consonants is observed.[3] In stage II the pitch lowering after [b] has become exaggerated to such an extent that it cannot be entirely predicted on the basis of the universal effect of a preceding voiced consonant. Rather, the lower initial pitch in the following vowel has become extrinsic, a process which I refer to as 'phonologization' (cf. Hyman 1972a, 1973).[4] Finally, in stage III, the voicing of **b* has been lost and a rising tone has become 'phonemic'. These stages essentially recapitulate the well-known development of Pekinese second tone (35) from an earlier high (55) tone with voiced initial.

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[1] There is some question as to whether (voiced) sonorants always lower pitch, especially if they are intervocalic. As I argued in Hyman (1973) and Hyman and Schuh (1974), sonorants are neutral with respect to the raising and lowering observed in tone rules.

[2] Matisoff suggests that the *p/b* contrast can only develop a bifurcation of an already existing tone, rather than provide the basis for the development of a first tonal contrast. This suggests perhaps that the F_0 differences are not readily made extrinsic unless previously existing tones make speakers 'tone-prone'. If the speakers of a language are already sensitized to tone, when /p/ and /b/ threaten to merge, F_0 is a logical parameter to generalize on.

[3] In the examples the [p] of [pá] has little or no pitch-raising effect because the high tone is already high in pitch. One would see the effect of this [p] much better if the following vowel were realized on a low tone.

Looking at the derivations in Table I, the three stages represented define two 'processes', as seen below:

Stage I > Stage II = phonologization
Stage II > Stage III = phonemicization

As seen from the example, the use of the term 'phonologization' should not be confused with that of Jakobson (1931), where the French term 'phonologisation' is better translated as 'phonemicization'. An intrinsic variation first becomes extrinsic (phonological) and then may become distinctive (phonemic).

I think that there is little, if any, disagreement on the logical necessity of three separate stages to account for the above (and other comparable) sound changes. However, it is too easy to overlook the role played by speaker/hearers in the phonologization and phonemicization processes. Perhaps we cannot predict when something phonetic will become phonological, or when something phonological will become phonemic, but at least we can investigate what is happening to a speech community when a new phonological rule (e.g. $55 \rightarrow 35 / b\_\_\_$) comes into a language.

In order to approach this question, it is necessary to consider what each of three stages (intrinsic-phonetic, extrinsic-phonological, distinctive-phonemic) represents for its speakers. And to consider this, we will have to artifically abstract or idealize three homogeneous communities — i.e. a community where everyone is simultaneously at stage I; a community where everyone is at stage II; and a community where everyone is at stage III. Let us keep the same example for the time being.[5]

Stage I. As mentioned above, the fundamental frequency (F_0) perturbations associated with voiced vs. voiceless consonants are not separately programmed, articulatorily. The dip in F_0 after [b] is thus a function of the voicing of that consonant, and not of the following vowel. At this intrinsic stage, it is tempting to conclude that F_0 is not important for speech, that it has little or no relevance for speakers, because it is in fact not 'intended'. However, it has been shown, first, that the range of F_0

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[4] Prof. Gsell of the Institut de Phonétique (Paris III) has suggested Trubetzkoy's term 'transphonologisation' which is apt here; cf. Maran's (1973) term 'cognitivization'.

[5] It will become apparent that the necessary idealizations invoked here disguise a much more complex situation. I am, however, assuming homogeneous communities only with respect to the rule(s) in question.

perturbations universally caused by voiced and voiceless consonants on the following vowel are indeed perceptible (Hombert 1974, 1975a,b); and second, it has been shown that these F_0 perturbations can be — and actually are used as voicing cues (Chistovich 1969, Haggard et al. 1970, Lea 1973). Thus, even if it can be demonstrated that these F_0 perturbations are unplanned byproducts of voicing states, we cannot dismiss the implications for speech perception. I shall return to this below.

Stage II. When the F_0 perturbations are exaggerated to a degree which cannot be attributed solely to universal phonetics, we speak of a phonologization process.[6] We hypothesize then that in stage II, the rising tone observed in [bǎ] is programmed separately from the initial consonant. What's more, this tone is apparently not as effective as a voicing cue as was the slight perturbation in stage I (see below, however). The F_0 rise is used instead to identify a *phonological* tone on the vowel — even though from a strictly phonemic point of view, the high tone of [pá] and the rising tone of [bǎ] are in complementary distribution. If we assumed otherwise, namely that it is the voicing distinction which is primary and the pitch secondary, we would be unable to explain — or even describe in a coherent fashion — how stage II becomes stage III (where the voicing of [b] is lost). In other words, the phonologization process must not be seen as reinforcing the voicing of [b] (which had originally given rise to the intrinsic variations). Rather, the phonologization process must be interpreted literally: something becomes phonological, and *at the expense* of something else.

Another way of stating this is that accompanying every phonologization is a potential dephonologization. Or, in the terminology of Vennemann (1972), when the phonologization process has been completed, i.e. when we arrive at a homogeneous stage II, there has been a 'rule inversion' — in this case a feature inversion. We start in stage I with the following universal phonetic 'rule' in (1):

(1) a → slightly lowered / $\underset{\text{C}}{[+\text{voice}]}$ _____ (intrinsic/stage I)

A sound change is introduced by which the intrinsic pitch lowering represented by (1) is exaggerated. However, the corresponding phonological rule in (2),

(2) á → ǎ / $\underset{\text{C}}{[+\text{voice}]}$ _____ (transitional stage)

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[6] One might distinguish between *quantitative* and *qualitative* phonologization. The first involves exaggeration of an intrinsic variation. The second involves a further phonetic modification which destroys the 'naturalness' of the original intrinsic variations. Thus, if [b] exerts a tone-depressing effect, as in Shona, and then becomes an implosive (which should have a tone-raising effect), tone-depressing has necessarily become phonologized.

which says that a high tone becomes a rising tone after a voiced consonant, can only be maintained in a *transitional* period. Once we have achieved stage II, the rule in (2) is replaced by the inverted rule in (3),

(3) $C \rightarrow [+\text{voice}] \,/\, \underline{\quad\quad} \;\check{a}$ (extrinsic/stage II)

which says that a consonant becomes voiced before a rising tone. In this conceptualization, rules (1) and (3) are parallel in an important way. In (1), what is on the right of the arrow, i.e. slight F_0 dip, was said to be a perceptual cue for what is in the environment, i.e. voicing. Similarly, we can hypothesize that in (3) the voicing to the right of the arrow is now a (redundant) perceptual cue for what is in the environment, i.e. rising *tone*.[7]

Stage III. The final stage arises in the above framework when the inverted rule (3) is dropped entirely from the language.

These three stages in the development of a rising tone are summarized with respect to their production and perception correlates in Table II.

TABLE II

Stage	*Correlates*
I. Intrinsic	(a) production - F_0 variations automatic (b) perception - F_0 variations a voicing cue
II. Extrinsic	(a) production - F_0 variations not automatic (b) perception - F_0 variations a tone cue[8]
III. Phonemic	(a) production - same as IIa (b) perception - same as IIb

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[7] These three stages can be expanded to include the various transitions and confusions which accompany rule inversion and rule loss. In an unpublished paper presented at the Fifth Annual Conference on African Linguistics, Stanford University, I discussed the following five stages involved in the development of [Ṽ] from *VN:

Stage I	VN pronounced with intrinsic nasalization only; no phonological rule yet
Stage II	ṼN pronounced with gradually more vowel nasalization; final nasal still perceptually prominent; phonological rule $V \rightarrow \tilde{V} \,/\, \underline{\quad\quad}\, N\ \$$ gradually comes into being
Stage III	ṼN pronounced with more and more vowel nasalization; final nasal gradually weakened; phonological rule of stage II gradually is replaced by an 'inverted' rule of the form $\emptyset \rightarrow N \,/\, \tilde{V} \,\underline{\quad\quad}\ \$$
Stage IV	heavy nasalization; final nasal which is usually not pronounced is inserted (when present) by the moribund inverted rule of stage III
Stage V	Ṽ becomes phonemic with ultimate loss of nasal insertion rule

[8] One possibility which I have not considered here is that the voicing of the prevocalic consonant may also be a tone cue.

While I shall address myself later to the various properties of such historical developments, a clear generalization emerges from the contents of Table II: *the development of a phonological rule carries the seeds of its own destruction*. An intrinsic variation becomes a phonological rule which then loses its phonetic motivation and is eventually dropped from the language entirely. In order to ascertain the generality of such events, let us turn to a second example, one much less documented than the development of tone from consonantal contrasts, and then return to the discussion of Table II.

The example I have in mind concerns what I refer to as 'obstruentization' in the context of a high vowel. Given a C_1VC_2 sequence, where $V =$ a high vowel, both C_1 and C_2 can be obstruentized by V, which in turn is also subject to obstruentization.[9] Although it would be an interesting study to look at the high vowel environment in general, I shall be concerned here only with what happens to consonants when they *precede* a high vowel. It is well known that /i/ and /ü/ can palatalize, that /ü/ and /u/ can labialize, that /u/ and /ɯ/ can velarize, and that all four can affricate a preceding consonant. However, those of us working on Comparative Bantu are used to diverse C_1 modifications which owe their existence to the 'noise' factor frequently surrounding and/or accompanying high vowels. The reconstructed 'super-closed' vowels **į* and **ų* of Proto-Bantu are supposed to have been noisy or strident, and it is not unusual to find cases of affrication, assibilation and change of place of articulation of C_1 before these vowels. Thus, **kų* comes out as [fu] in Luganda, as seen in the following forms provided by Talmy Givón:

(4) *Verb* *Adjective*

-afika 'be cracked' → -afifu 'cracked'
-ewuka 'be light' → -ewufu 'light-weighted'

The synchronic alternation between [k] and [f] in present-day Luganda is accounted for by the following historical derivation:

(5) kų > kXu > kfu > pfu > fu

The processes involved are: 1) development of noisy release (X) before high vowels; 2) affrication agreeing in labiality with the following vowel; 3) place of articulation agreement within the affricate; and 4) de-affrication. All of the intermediate stages are attested in various Bantu languages (see Ponelis 1974 for examples).

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[9] In addition, the 'apical' vowel phenomenon in Chinese (Baron 1974), where historical **pi* comes out sounding to my ears as [p] followed by syllabic [z], as well as the frequently strident release of French *oui* [wih] can be cited as instances of obstruentization occuring in the context of high vowels (cf. Limbum [ḿbv́] 'goat' with two syllables, discovered by Jan Voorhoeve, which derives from historical **mbi*).

In Hyman (1972b) I pointed out that most of the Bamileke dialects (spoken in Cameroon) are characterized by a phonological rule of the form in (6):

(6) $$\mathrm{C} \rightarrow \mathrm{Ch}\ /\ \underline{\quad\quad}\ \underset{\mathrm{V}}{[+\mathrm{high}]}$$

Both voiceless and voiced consonants become aspirated (a form of obstruentization) before the high vowels /i/, /u/ and /ɯ/, as seen in the synchronic derivations in (7), taken from Feʔfeʔ dialect:

(7) /tī/ → [thī] 'to forge'
/tǔ/ → [thǔ] 'head'
/tɯ̌/ → [thɯ̌] 'tree'

The same change of /d/ to [dh] occurs before these vowels.[10] The aspiration which occurs in Bamileke can thus be viewed as a phonologization of the intrinsic noise factor associated with high vowels.

However, it is noticed that in the Bamileke dialects characterized by aspiration before high vowels, further modifications usually take place. In particular, there is considerable evidence that speakers have focused more and more attention on the consonant and less and less attention on the high vowel. Thus, each attested modification reinforces the identity of the consonant to the detriment of that of the original vowel. Let me confine myself to two dialects, Feʔfeʔ and Dschang.[11] As seen in (8),

(8) *tu > thu > tsu > tsə
*tom > tuu > tu

a recent vowel-length distinction has arisen through the loss of final consonants in Feʔfeʔ dialect. However, in the Banka variety of Feʔfeʔ [thu] has become [tsu], and the vowel length distinction has been obscured (especially by younger speakers). The final change of [tsu] to [tsə] has occurred in Babouantou (contiguous with Banka), proof that the vowel quality has received less and less attention by listeners (Bandjoun dialect and its neighbors are also characterized by this vowel reduction).

In Dschang dialect, after consonants became aspirated before high vowels, a second change took place as follows:

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[10] Jean-Marie Hombert and I observed in the Phonology Laboratory in Berkeley that such words in Dschang as [m̀bhə̂] 'dog' consisted of a voiced period followed by a voiceless 'h' period and then a voiced period again. It is clear that we are dealing with voiced aspirates rather than with breathy voiced consonants.

[11] The Dschang data and much of the analysis is owed to Maurice Tadadjeu.

(9) i, u, ɯ > e, o, ə / Ch ____

That is, historical **pu*, after becoming [phu], later went on to become [pho]. The result is that [pho] now stands in opposition to [po] from historical **po*. Thus, what started out as a vowel quality difference between **u* and **o* has now been completely restructured (from a perceptual point of view at least) as a contrast between aspirated and unaspirated consonants.

Thus, it can be argued that when aspiration is phonologized, this automatically sets the scene for other imminent changes, e.g. affrication, vowel mergers, etc. Stated in general terms, there are certain phonological rules such as aspiration before high vowels that are in essence *self-destructive*: once they catch on they automatically cause a perceptual rephonologization. Thus, as in the **pa/*ba* case discussed earlier, we might say that once consonants become heavily aspirated before high vowels, the highness of the vowel becomes redundant on the basis of the aspiration. This may seem paradoxical, but on the other hand, the phonological rule would not have caught on if aspiration were not becoming the primary perceptual cue for paradigmatic contrasts. The secondary changes which ensue attest to this, since they reinforce the aspirated/unaspirated contrast to the detriment of the high vowel/non-high vowel contrast.[12]

Returning now to Table II, we might propose the same stages (intrinsic, extrinsic, phonemic) for the history of aspiration in Dschang dialect. Aspiration first became a phonological property of the language and is now phonemic.

Two questions immediately arise. First, if the F_0 variations in the first example are perceptible, and in fact are used to identify prevocalic voicing, what does it mean to phonemicize the *p/b* contrast as one of voicing rather than as one of pitch? Some objective means must be established for 'hierarchizing' feature differences between contrasting elements. Traditionally, phonologists have relied on structural considerations ('pattern congruity', 'symmetry', etc.) in such cases. Thus, consider the *p/b* contrast in postvocalic position. It is generally accepted (though some discussion persists) that the *p/b* contrast does not cause F_0 differences on a preceding vowel.[13] On the other hand, vowel length differences observed in such English words as *cap/cab* can be attributed to the difference in voicing in the final consonant.[14] If we failed to represent the 'phonemic' contrast between /p/ and /b/ as one of voicing, we would be forced to set up underlying F_0 distinctions postconsonantally, but underlying vowel length distinctions preconsonantally. It is evidently simpler to keep the same structural contrast everywhere. Phonologists do this despite the greater perceptual prominence of vowel duration differences than voicing differences in pairs such as *cap/cab* (Denes 1955). In fact, the /b/ of *cab* may not be voiced at all, in which case we get [kæp] vs. [kæ:p].

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[12] The same can be said for the Central Bantu phenomena, since although consonants have become modified before high vowels, the mid-high vowels **e* and **o* have raised and merged with the high vowels in most Bantu languages. Thus, **kų* may come out [fu] and **ko* may come out [ku], showing again that the consonant has taken over the distinctive function.

[13] See in particular Lea (1973) for a phonetic study of English, and Hyman (1973) for some data from African tone languages. Both show that pitch *drops* before both voiced and voiceless obstruents.

Returning to prevocalic position, F_0 perturbations probably represent a less important perceptual cue for the *p/b* contrast than differences in aspiration — which in turn are more salient perceptually than the voicing itself. That is, *pan* [phæn] and *ban* [bæn] are best distinguished by the aspiration difference rather than any possible difference there may be in voicing in the initial consonant (John Ohala, personal communication).

Since it is frequently pointed out that English voiced obstruents are not fully voiced, we may be witnessing a rephonologization, which may go on to become phonemic, as in Table III.

TABLE III

/pa/	→	pha	>	pha
/ba/	→	ba	>	pa
/ap/	→	ap	>	ap
/ab/	→	a:b	>	a:p

The voicing distinction is in trouble in English, as it has been in so many languages historically. We still may keep [b] intervocalically — and of course sonorant consonants appear to be holding their own. The above facts suggest that secondary or linked features such as pitch, vowel length and aspiration frequently supplant the voice distinction in languages. The first principle of phonologization therefore is that an intrinsic variation linked to a feature X becomes phonologized only to destroy the feature X which engendered it — be it voicing or vowel height.

The second question is a rather grave one: if in Table II, stages II and III are identical in terms of production and perception, why should we distinguish them? That is, why shouldn't we just say that *tone* is already 'phonemic' at stage II, rather than waiting for stage III? Here the problem is determining at what point two elements A and B become *differentiated*. When we have [pá] and [bǎ], are the high and rising tones the same entity, or two different entities? Every brand of phonemic analysis would say they are the same, since they are in complementary distribution, and yet *people* behave as if they are different. The same for aspiration before high vowels — are the consonants of [thu] and [to] the same entity, or two different entities? Can one really say that aspiration is 'redundant' or that it does not represent a 'distinctive choice' when subsequent generations favor it over the so-called distinctive vowel height parameter?

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[14] See Chen (1970) for a cross-linguistic study of vowel length variations before voiced vs. voiceless consonants.

The two problems which arise, then, in the study of phonologization and phonemicization concern, first, the place of intrinsic variation within a language description, and second, the problem of differentiation. Both of these problems, I would like to argue, result from a number of confusions, and especially from the inadequacy of (static) structural phonology. In answer to both of these questions one need but point out that both traditional phonemics and generative phonology provide structural statements concerning the sound patterns of languages, which cannot be equated in any obvious way with the production and perception strategies which are used by speaker/hearers — and *which determine the course of phonological change*. The generative model is frequently confused with production and is accused of being speaker-oriented; the phonemic model is frequently confused with perception and is often maintained to be hearer-oriented.[15] Both represent neither. Neither is suited to handle the dynamics of phonological change, because both insist on structure. But both ignore process.

In a recent paper (1975) I illustrated by means of examples dealing with nasality an approach incorporating the state/process dichotomy established by Joseph Greenberg (see especially Greenberg 1969, Bell 1971). The position outlined there was that in order to explain the properties of sounds, it is necessary to distinguish between *states* and *processes* which affect each other in intricate ways. The structural properties of phonological states are interesting only insofar as they are related to actual strategies for realizing these states. Thus, structurally a language may have a penultimate accent, but speakers will have strategies for realizing (and detecting) that accent. It is these strategies which seem to take precedence over structure in phonological change. In order for a change to catch on (and become a phonological 'rule') it is necessary for it to be perceived and diffused throughout a speech community. In that way phonological change is perception-oriented, even though the seeds for a change may be articulatory.[16] The strength of the state/process approach to language is that it places structure within its proper perspective. One cannot explain human behavior (e.g. sound change) with a model which sees only structure as an underlying force. On the other hand, one cannot deny the existence of structure. Thus, a language's phonemic structure exerts an effect on the treatment of foreign sounds and sound sequences, as seen either in borrowing or in foreign accents. The two problems arising from Table II prove that structural phonology must be embedded into a broader theory of how people deal with structure in communicating, and how their *use* of language determines the direction of phonological change.

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[15] Thus, Wells (1947:271) states: "Phonemics takes the point of view of the hearer".

[16] Another indication of the perception-orientation of phonologization has been pointed out to me by Jean-Marie Hombert. Hombert has focused on cases where intrinsic variations are apparently never phonologized (or only rarely), and suggests that this may have to do with our perceptual capabilities. One such example is the failure of tonal contrasts to develop

Baron, S. 1974. "On the tips of many tongues". Paper presented at the Seventh International Conference on Sino-Tibetan Languages and Linguistics, Atlanta.

Bell, A. 1971. "Some patterns of occurrence and formation of syllable structures". *Working Papers on Language Universals* (Stanford University) October, pp.23-137.

Chen, M. 1970. "Vowel length variation as a function of the voicing of the consonant environment:. *Phonetica* 22.129-159.

Chistovich, L.A. 1969. "Variations of the fundamental voice pitch as a discriminatory cue for consonants". *Soviet Physics-Acoustics* 14.372-378.

Denes, P. 1955. "The effect of duration on the perception of voicing". *Journal of the Acoustical Society of America* 27.761-764.

Greenberg, J.H. 1969. "Some methods of dynamic comparison in linguistics". *Substance and Structure of Language*, ed. J. Puhvel, 147-203.

Haggard, M., S. Ambler and M. Callow. 1970. "Pitch as a voicing cue". *Journal of the Acoustical Society of America* 47.613-17.

Haudricourt, A.-G. 1961. "Bipartition et tripartition des systèmes de tons dans quelques langues d'Extrême-Orient". *Bulletin de la Société de Linguistique de Paris* 56.163-80.

Hombert, J.-M. 1974. "Production and perception: their respective roles in one case of tonal development". Paper presented at the Annual Linguistic Society of America meeting, New York.

Hombert, J.-M. 1975a. "The perception of contour tones". *Proceedings of the First Annual Meeting of the Berkeley Linguistics Society* 221-232.

Hombert, J.-M. 1975b. *Towards a Theory of Tonogenesis: an Empirical, Physiologically and Perceptually-based Account of the Development of Tonal Contrasts in Languages.* Ph.D. diss. University of California, Berkeley.

Hyman, L.M. 1972a. "Nasals and nasalization in Kwa". *Studies in African Linguistics* 3.167-205.

Hyman, L.M. 1972b. *A Phonological Study of Feʔfeʔ-Bamileke.* Studies in African Linguistics, Supplement 4.

from earlier vowel height differences. Although [i] has a higher intrinsic fundamental frequency than [e], we do not find cases of where the two vowels merge as [i], with earlier [e] having a lower tone than earlier [i].

Hyman, L.M. 1973. "The role of consonant types in natural tonal assimilations". *Consonant Types and Tone*, ed. L.M. Hyman, 151-79. University of Southern California.

Hyman, L.M. 1975. "Nasal states and nasal processes". *Nasalfest: Papers from a Symposium on Nasals and Nasalization*, edd. C. Ferguson, L.M. Hyman and J.J. Ohala. Special Publication, Stanford University Universals Project.

Hyman, L.M. and R.G. Schuh. 1974. "Universals of tone rules: evidence from West Africa". *Linguistic Inquiry* 5.81-115.

Jakobson, R. 1931. "Prinzipien der historischen Phonologie". *Travaux du Cercle Linguistique de Prague* 4.247-267.

Lea, W.A. 1973. "Segmental and suprasegmental influences on fundamental frequency contours". *Consonant Types and Tone,* ed. L.M. Hyman, 15-70. University of Southern California.

Maran, L.R. 1973. "On becoming a tone language: a Tibeto-Burman model of tonogenesis". *Consonant Types and Tone*, ed. L.M. Hyman, 97-114. University of Southern California.

Matisoff, J.A. 1973. "Tonogenesis in Southeast Asia". *Consonant Types and Tone*, ed. L.M. Hyman, 71-95. University of Southern California.

Ohala, J.J. 1973. "The physiology of tone". *Consonant Types and Tone*, ed. L.M. Hyman, 1-14. University of Southern California.

Ponelis, F. 1974. "On the dynamics of velarization and labialization: some Bantu evidence". *Studies in African Linguistics* 5.27-58.

Vennemann, T. 1972. "Rule inversion". *Lingua* 29.209-242.

Wang, W.S.-Y. and C. Fillmore. 1961. "Intrinsic cues and consonant perception". *Journal of Speech and Hearing Research* 4.130-36.

Wells, R.S. 1947. Review of K.L. Pike, *The Intonation of American English*. *Language* 23.255-73.

Doubling and Reduplication in Hausa Plurals

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0. Introduction

One of the most troublesome features of Hausa morphology is the variety of ways in which plurals are related to singulars. Past descriptions (Abraham 1959a, b, Parsons (MS), Kraft and Kraft 1973, Dunn 1975) have focused largely on the problem of identifying the various plural classes and determining what subclasses exist within each class and what types of singular forms are most likely to have a given plural form. With one important exception — Newman 1972 — previous accounts have not attacked the problem from the point of view of determining what regularities in plural forms make them relatable to their corresponding singulars. This is unfortunate, since otherwise it is impossible to explain why, given that Hausa speakers associate the short vowel and doubled consonant of Class 2 plural[1] *ƙâttáa* 'huge' with the long vowel and short consonant of the corresponding singular *ƙáatòo*, they fail to identify the short vowel and doubled consonant of Class 5 plural *bákkúnàa* 'bows' with the long vowel and single consonant of the singular *bàakíi* 'mouth'; instead, *bákkúnàa* is interpreted only as the plural of *bàkáa* 'bow', while *bàakíi* has the plural form *báakúnàa* 'mouths'. Similarly, it is necessary to explain why, although the plural *báakúnàa* has the reduplicative variant *báakúnkúnàa* 'mouths', in which the second syllable has been reduplicated, the plural *bákkúnàa* does not have the reduplicative variant **bákkúnkúnàa* but rather *bákúnkúnàa*. The present account aims to formulate the structure of Hausa plurals in such a way that questions like these will be answered.

1. The interpretive function of morphological and phonological rules

Hausa plurals pose a number of problems for an account that conforms with the normal assumptions of generative phonology about how the vocabulary of a language is structured. For example, if we assume that a related word pair such as singular/plural *bàkáa/bákkúnàa* is captured by positing that the underlying form of the root *bàk-* has a particular plural affix assigned to it by a morphological rule and that this root-affix combination then undergoes phonologically and morphologically conditioned changes, we find that our account will entail a great number of ad hoc markings. According to the traditional treatments, there are about ten different plural classes, many of them with subclasses whose membership is not totally predictable. Furthermore, a large number of Hausa nouns and adjectives, if not the majority, have a variety of plural forms, all with the same meaning. In some cases, a given plural may predominate in certain dialectal areas, but in general the alternate plural forms are recognizable by speakers of any Hausa dialect. For example, Abraham's dictionary lists four plurals for the singular *bùnsúrúu* 'billy goat': *bùnsùrái*, *búnsúràa*, *búnsúróorii*, *búnsúrràa*. But attested for *gàatárii* 'axe' are only the alternants *gáatúràa* and *gáatúrràa*. (The forms *búnsúrràa* and *gáatúrràa* are found mainly in the Sokoto and Katsina dialects; the present account will in general restrict itself to Kano dialect, although as far as I have been able to tell, it could easily be extended to the other dialects.)

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[1] In this paper I follow Parsons' (MS) numbering of the plural classes.

A number of other complexities will be detailed below, but even if we restrict our attention to the sorts of irregularities and sub-regularities already mentioned, it is clear that the standard assumption that plurals are derived synchronically from singulars would clutter the lexicon with diacritic features. For example, *bùnsúrúu* would have to be marked as taking plurals in Classes 8b, 5d, and 4 in Kano Hausa, while *gàatárii* would be marked as taking plurals only in Class 5d. But listing the singular forms in the lexicon with a set of diacritics to indicate which plurals they take is tantamount to listing the plurals individually in the lexicon and somehow indicating which singular a given plural form corresponds to. The latter approach in fact seems more direct and is supported by several considerations. For one thing, it avoids the problem posed by nouns that either have a plural form with no corresponding singular (such as *kúɗii* 'money') or have a plural form that does not exhibit a regular correspondence to a singular (such as *máatáa*, the plural of *màčè* 'woman'). If we took the position that all plurals were formed on the basis of singulars, we would have to invent a fictitious singular form for *kúɗii* and formulate an ad hoc rule to derive *máatáa* from *màčè* (along with adding an ad hoc diacritic feature to *màčè* to signal the fact that its plural is *máatáa* and not **máčóočii*, etc.). If, on the other hand, we list plurals in the lexicon and regard the various morphological and phonological rules of Hausa as defining a procedure for parsing morphologically complex forms, any attempt to identify *kúɗii* and *máatáa* as grammatically corresponding to some attested singular will fail; this is the desired result, since these forms are truly irregular. Further benefits of the lexical listing of plurals will emerge once we encounter the more difficult plural classes, in sections 3, 4, and 5.

One might at first object to the notion that even the more regularly formed plurals are listed in the lexicon, since this proposal significantly increases the size of the lexicon. But the learnability of a list is determined not only by the number of entries but also by their complexity. The complexity of a list is lessened to the extent that it can be shown to have a structure. On the other hand, it is not clear that we can measure the complexity of listing both singulars and plurals against the complexity of listing only singulars, but with diacritics to indicate which plurals they take. In either case, the grammar requires morphological rules relating singulars with plurals, since both types of account must reflect the fact that knowledge of the language permits speakers to identify novel plural forms correctly without having to be told what the corresponding singular is. Cf. Jakendoff (1975) for discussion of this and related points.

For reasons similar to those which motivate the listing of plural forms in the lexicon, this account will also assume that lexical representations are expressed in surface forms rather than in abstract underlying forms and that the normal function of phonological rules is an interpretive one: their purpose is to determine whether a given pair of words is morphologically related. Derivations, which are somewhat the reverse of derivations in standard generative phonology, proceed by examining two words with respect to some morphological rule. If allomorphic differences prevent the lexical (i.e. surface) forms from fitting the rule, then the effects of phonological rules are undone in succession, starting with the lowest-level rule first. If the phonology succeeds in taking the forms back to more abstract representations that satisfy the morphological rule, the derivation establishes that the words are related. The theoretical and empirical justification of this proposal is developed in some detail in Leben and Robinson (1975), and the present treatment, insofar as it succeeds in determining which plurals are associated with which singulars, further supports the general proposal.

Only fully regular morphological and phonological processes will apply in the formation of new plurals from singulars. Otherwise, the function of the morphological and phonological rules is simply to parse the existing lexicon by proceeding from surface forms to more abstract representations. In this paper I concentrate on the latter function of the rules, and I employ the following conventions.

(1) Conventions on rule application.

a. If a conventional generative phonology contains rules A, B, and C in that order (and if these rules are also motivated in the inverted system), then these rules are undone in the opposite order: C, B, A.

b. Application of a rule A → [−F] / Y____Z consists of replacing [−F] with [+F] on A in the environment Y____Z. Analogously, an insertion rule 0 → A / Y____Z applies by deleting A from the context YAZ, and a deletion A → 0 / Y____Z applies by inserting A between Y and Z.

c. A rule blocks if undoing it would not increase the compatibility of forms W_1 and W_2 with respect to morphological rule R.

As a result of provision (1c), a derivation stops as soon as it is established that W_1 and W_2 are related by rule R. We may now see how a derivation works.

Class 2b plurals double the last consonant of the singular root; their plural suffix is *-áa*, and these plurals have a Fall-High tone pattern.

(2)	*Singular*	*Plural*	
	dámìi	dâmmáa	'bundle'
	ƙáatòo	ƙâttáa	'huge'
	góoròo	gwârráa	'kola nut'

The word formation rule for this plural class is:

(3) Class 2b

$$\underset{1\,2\,3\,4}{[\mathrm{CVCV}]_{sg.}} \Rightarrow \underset{1\,2\,3\quad 3}{[\mathrm{C\hat{V}C\text{-}C\text{-}}\acute{a}a]_{pl.}}$$

The derivation of *dámìi*/*dâmmáa* requires no phonological operations. The plural form matches the canonical plural in rule (3), and the singular matches the canonical singular; thus the parsing of *dâmmáa* as the plural of *dámìi* is sanctioned with no recourse to the phonology. The remaining two examples in (2) cannot be parsed at the surface, since the singular has a long vowel where the plural has a short one. The reason for this disparity is an automatic vowel shortening rule which applies in all Hausa closed syllables. The derivation of these two singular/plural pairs will proceed in the following way.

(4)	W_1	W_2	Morphology
Lexical forms:	ƙáatòo	ƙâttáa	$\underset{1\,2\,3\,4}{[\mathrm{CVCV}]_{sg.}} \Rightarrow \underset{1\,2\,3\quad 3}{[\mathrm{C\hat{V}C\text{-}C\text{-}}\acute{a}a]_{pl.}}$
a. V → [−long] / ____ C$	—	ƙâattáa	—

What occasions the undoing of the shortening rule is the mismatch in the length of the first syllables of W_1 and W_2. Once this rule is undone, the match is perfect, and the relationship between these words is established. At this point, the derivation stops.

The last example, *góoròo*/*gwârráa*, manifests not only the vowel length alternation seen above but also the neutralization which takes short mid vowels to *a* in closed syllables. (The difference in the initial consonants *g* and *gw* is not a real one; *g* is redundantly labialized before rounded vowels — cf. Greenberg (1941:317). For typographic convenience I will omit redundant labialization and palatalization from the transcription). This derivation will thus require an additional phonological rule to be undone.

(5)	W_1	W_2	Morphology
Lexical forms:	góoròo	gwârráa	$\underset{1\,2\,3\,4}{[\mathrm{CVCV}]_{sg.}} \Rightarrow \underset{1\,2\,3\;\;3}{[\mathrm{C\hat{V}C\text{-}C\text{-}}\acute{a}a]_{pl.}}$
a. $\begin{bmatrix}\mathrm{V}\\ -\mathrm{hi}\end{bmatrix} \rightarrow a\ /\ \underline{\quad\quad}\mathrm{C}\$$	—	$\mathrm{gw}\begin{bmatrix}\hat{\mathrm{V}}\\ -\mathrm{hi}\end{bmatrix}\mathrm{rr}\acute{a}\mathrm{a}$	—
b. $\mathrm{V} \rightarrow [-\mathrm{long}]\ /\ \underline{\quad\quad}\mathrm{C}\$$	—	$\mathrm{gw}\begin{bmatrix}\hat{\mathrm{V}}\\ -\mathrm{hi}\\ +\mathrm{long}\end{bmatrix}\mathrm{rr}\acute{a}\mathrm{a}$	

Condition (1c) sanctions the application of the rule in stage (a) of (5), because this permits the *a* of the first syllable of *gwârráa* to be taken back to a vowel that is closer to the mid vowel of the first syllable of *góoròo*. In derivation (4), on the other hand, this rule could not apply to *ƙâttáa* (even though its environment was met), since condition (1c) permits a rule to apply only if it makes the forms under comparison more similar. At stage (b) in (5), Vowel Shortening applies, yielding a representation in which the root of *gwârráa* is non-distinct from the root of *góoròo*. For the plural, we have the representation

$$\mathrm{gw}\begin{bmatrix}\mathrm{V}\\ -\mathrm{hi}\\ +\mathrm{long}\end{bmatrix}\mathrm{r\text{-}}$$

and for the singular, we have *goor-*. These are non-distinct, and so the derivation stops and the relationship between *góoràa* and *gwârráa* is declared valid by morphological rule (3). Note that for a relationship to be declared valid, it is not necessary to establish identity of allomorphs; non-distinctness suffices.

2. Some simple cases of doubling and reduplication

2.1. *Class 4 plurals.* A number of plural classes are like Class 2b *góoròo/gwârráa* in that they involve a straightforward morphological rule and some relatively productive phonological alternations. For instance, Class 4, the most productive class of present-day Hausa, is given by morphological rule (6), and examples appear in (7).

(6) Class 4

$$\begin{array}{lcl} [\mathrm{XCV}]_{\mathrm{sg.}} & \Rightarrow & [\acute{\mathrm{X}}\mathrm{C}\text{-}\acute{o}o\text{-}\mathrm{C}\text{-}\acute{\imath}i]_{\mathrm{pl.}} \\ \;1\,2\,3 & & \;1\,2\quad\;\;2 \end{array}$$

(7)

Singular	*Plural*	
báràa	báróoríi	'servant'
táagàa	táagóogíi	'window'
tášàa	tášóošíi	'station'
táasàa	táasóošíi	'bowl'
ƙóotàa	ƙóotóočíi	'handle'

In the last two items, the doubled consonant is palatalized by the following vowel. A summary of the changes of this type that are relevant for the present account appears in (8).

(8) Palatalization

$$\left\{\begin{array}{l} \mathrm{t} \rightarrow \check{\mathrm{c}} \\ \mathrm{d} \rightarrow \check{\jmath} \\ \mathrm{s} \rightarrow \check{\mathrm{s}} \\ \mathrm{z} \rightarrow \check{\jmath} \end{array}\right\} / \;\underline{\qquad}\; \begin{bmatrix} \mathrm{V} \\ -\mathrm{back} \end{bmatrix}$$

We may compare the derivations of *tášàa/tášóošíi* and *táasàa/táasóošíi*.

(9)	W_1	W_2	Morphology
Lexical forms:	tášàa	tášóošíi	Rule (6)

(10)	W_1	W_2	Morphology
Lexical forms:	táasàa	táasóošíi	Rule (6)
a. Palatalization	—	táasóosíi	—

In (9) the parsing can take place at the surface, since the surface forms of the singular and plural match rule (6). Note that the environment for undoing (8) Palatalization is met by the last *š* of *tášóošíi*, but the condition (1c) prevents this rule from applying, since it would not increase the compatibility of *tášàa* and *tášóošíi* with respect to word formation rule (6). In (10), on the other hand, the surface forms do not match the description of rule (6), since it requires that in the plural the same C both precede and follow infix *-óo-*. By undoing (8) Palatalization, we take the last *š* in the plural back to *s*, and now the parsing of *táasóošíi* as the plural of *táasàa* is sanctioned by rule (6).

2.2. *Class 8b plurals.* In this class the final C of the root is doubled, and the plural affix *-ái* is attached.

(11) Class 8b

$$\begin{array}{lcl} [\mathrm{CVCV}]_{\mathrm{sg.}} & \Rightarrow & [\mathrm{C}\grave{\mathrm{V}}\mathrm{C}\text{-}\mathrm{C}\text{-}\acute{a}i]_{\mathrm{pl.}} \\ \;1\,2\,3\,4 & & \;1\,2\,3\;\;3 \end{array}$$

(12)

Singular	*Plural*	
yàbóo	yàbbái	'praise'
kádòo	kàddái	'crocodile'

2.3. *Class 8c plurals.* This class is different from the preceding in that the affix *-ai* is reduplicated along with the final C of the root. It would be difficult to relate this class to 8b, since, among other things, the tone patterns of the two plurals are different.

(13) Class 8c

$$\begin{array}{lcl} [XCV]_{sg.} & \Rightarrow & [\acute{X}C\text{-}\grave{a}i\text{-}C\text{-}\acute{a}i]_{pl.} \\ \ 1\,2\,3 & & \ 1\,2\quad\ \ 2 \end{array}$$

(14)

Singular	*Plural*	
wáakée	wáakàikái	'beans'
káašíi	káasàisái	'excrement'
hánǰíi	hánzàizái	'entrails'

For the last two items, parsing does not take place at the surface. (8) Palatalization must first be undone in the singular forms, yielding the more abstract representations /káasíi/ and /hánzíi/, which now form correct inputs to rule (13). Note that this account manages to state general morphophonemic changes without taking the position that abstract forms like /káasíi/ and /hánzíi/ are listed in the lexicon.

3. Class 5 plurals

Newman (1972) has observed that in Class 5, syllable weight is an important factor in the shape of the plural form. In addition to the examples that can be analyzed as taking some form of the singular root followed by the suffix *-únàa*, *-úwàa*, or *-úkàa*, there are a good number which take a reduplicative alternant with no difference in meaning. Let us first consider plurals in *-únàa*.

(15)

	Singular	*Plural*	*Reduplicative Plural*	
a.	bàkáa	bákkúnàa	bákúnkúnàa	'bow'
	dámìi	dámmúnàa	—	'bundle'
	jàkáa	—	jákúnkúnàa	'bag'
b.	kwánkòo	kwánkúnàa	—	'tin can'
	háncìi	hántúnàa	—	'nose'
	hántàa	hántúnàa	—	'liver'
c.	bàakíi	báakúnàa	báakúnkúnàa	'mouth'
	jàakíi	jáakúnàa	—	'donkey'
	ɗáakìi	ɗáakúnàa	—	'hut'

As Newman observes, the unreduplicated plurals take a double of the second root consonant if the root syllable is light (15a); otherwise Doubling does not take place. By contrast, the reduplicative forms behave identically regardless of whether the root syllable is light or heavy. Newman analyzes the reduplicative forms in (15a) as undergoing doubling of the final C of the singular root CVC, yielding CVC-C, and then inserting *-un-*, which he regards as a truncated form of *-unaa*, before the double, along with adding the full form *-unaa* after the double: CVC-*un*-C-*unaa*. But this account misses the fact that the reduplicative forms of (15c) have the same pattern as those of (15a) even though the non-reduplicative plurals of (15b, c) behave differently from those of (15a). A further sign that Doubling is not responsible for the double of the root consonant in the reduplicative forms is that *jìkíi* 'body', whose non-reduplicative plural, *jíkúnàa*, is exceptional in that it does not take a doubled consonant, does have a copy of *k* in the reduplicative plural: *jík-ún-k-únàa*.

These facts show that the reduplicative plural cannot be regarded as a result of doubling or not doubling in the non-reduplicative plural. Instead, there is a separate reduplication rule that takes **bákúnàa* to *bákúnkúnàa*, *báakúnàa* to *báakúnkúnàa*, and so on:

(16) Reduplication

$$\begin{array}{ll}[\mathrm{CV(C)C}]_{\mathrm{R}}\text{-}\mathit{un}\text{-}\mathit{aa} \Rightarrow & [\mathrm{CV(C)C}]_{\mathrm{R}}\text{-}\mathit{un}\text{-C-}\mathit{un}\text{-}\mathit{aa}\\ 1\;2\;3\;4\quad 5\;\;6 & 1\;2\;3\;4\quad 5\;4\;5\;6\end{array}$$

The symbol R designates the root. The *-unaa* suffixation process is expressed in (17).

(17)

$$\begin{array}{ll}[\mathrm{QV}]_{\mathrm{sg.}} \Rightarrow & [\acute{\mathrm{Q}}\text{-}\textit{únàa}]_{\mathrm{pl.}}\\ 1\;2 & 1\end{array}$$

To capture Newman's observation on the importance of syllable weight in the structure of these plurals, we specify that in the plural, the variable Q ends in a heavy syllable followed at least by a consonant:

(18) Definition of Q

$$\mathrm{Q} = \mathrm{X}\begin{Bmatrix}\mathrm{C}\bar{\mathrm{V}}\\ \mathrm{CVC}\end{Bmatrix}\mathrm{YC} \quad \text{in plurals}$$

The reason for including the variable Y in this definition is to permit additional material to intervene before the final consonant. For justification see the discussion below derivation (21).

Doubling applies when the root consists of a light syllable and a single consonant.

(19) Doubling

$[\mathrm{C\check{V}C}]_{\mathrm{R}}$-*unaa* ⇒ $[\mathrm{C\check{V}C}]_{\mathrm{R}}$-C-*unaa*
1 2 3 4 1 2 3 3 4

Some sample derivations follow.

(20)	W_1	W_2	Morphology
Lexical forms:	dámìi	dámmúnàa	$[\mathrm{QV}]_{\mathrm{sg.}}$ ⇒ [Q́-*únàa*]$_{\mathrm{pl.}}$ 1 1
a. (19) Doubling	—	dám-únàa	—

To capture the exceptionality of *jìkíi/jíkúnàa*, which unexpectedly does not undergo doubling of *k* even though the root has a light first syllable, we require that well-formed plurals meet the requirements of the morphological rule at some stage of the derivation. By this stipulation, the plural in (20) is well-formed because at the surface (the first line of the derivation) the plural meets the condition on Q — it has the heavy syllable *dám-* followed by the consonant *m* — and it has the plural ending *-únàa*; at stage (a) the plural satisfies the rest of the morphological rule, namely the requirement that what precedes *-únàa* be non-distinct from the singular stem. The exceptional example *jíkúnàa* is parsed by (17) as *jík* plus *-únàa*, but since it never reaches a stage in which it satisfies the condition on Q, it is judged an improperly formed plural. This does not bar *jíkúnàa* from the lexicon — for if morphological rules were interpreted in general as well-formedness conditions on the lexicon, a great number of words would be ruled out that nonetheless show remarkable persistence — but it in effect marks this form as an exception.

(21)	W_1	W_2	Morphology
Lexical forms:	bàkáa	bákúnkúnàa	$[\mathrm{QV}]_{\mathrm{sg.}}$ ⇒ [Q́-*únàa*]$_{\mathrm{pl.}}$ 1 2 1
a. (16) Reduplication	—	[bák]$_{\mathrm{R}}$-ún-àa	—

Bákúnkúnàa meets the condition on Q in its lexical form, since to the left of *-únàa* it has a heavy syllable *bák-* followed at least by a consonant. At stage (a) it meets the remaining condition, that it be composed of the singular root followed by the ending *-únàa*.

This account not only provides for the correct parsing of *báakúnàa* as the plural of *bàkáa* but also explains why, as noted in the introductory section, *bákkúnàa* is not interpreted as the plural of *bàakíi* even though Hausa has a vowel shortening rule that could have taken **báakk-* to *bákk-*:

(22)	W_1 (= 'mouth')	W_2 (= 'bows')	Morphology
Lexical forms:	bàakíi	bákkúnàa	$[QV]_{sg.}$ ⇒ $[\acute{Q}$-*únàa*$]_{pl.}$
			1 1
a. V Shortening	—	báakkúnàa	—
b. (19) Doubling	—	—	—

Following Newman, (19) Doubling applies only when the root consists of a light syllable followed by a single consonant. Thus the rule blocks in (22), and so the derivation will never be able to reconcile the two *k*'s in the plural with the single *k* in the singular.

The formulation of (16) Reduplication and (19) Doubling also explains why the reduplicative plural of *bàkáa* could not be *bákkúnkúnàa*. Reduplication would take this form back to $[\text{bákk}]_R$-únàa, and Doubling would not be able to convert $[\text{bákk}]_R$ back to $[\text{bák}]_R$ since it requires that the doubled consonant be outside the root. This analysis correctly states that hypothetical *bákkúnkúnàa* could only be related to a singular of the form *bakkV*, where V is some vowel.

This account is easily extended to *-úkàa* and *-úwàa* plurals, which Parsons and Newman have recognized as belonging to the same class as the *-únàa* plurals.

(23)	*Singular*	*Plural*	*Reduplicative Plural*	
a.	bàtúu	—	bátúttúkàa	'conversation'
b.	zànčée	zántúkàa	zántúttúkàa	'conversation'
c.	ràafíi	ráafúkàa	ráafúffúkàa	'stream'
(24)a.	bàtúu	—	bátúutúwàa	'conversation'
	zánèe	zánnúwàa	—	'body cloth'
b.	hánnúu	hánnúwàa	—	'hand'
c.	yáaƙìi	—	yáaƙúuƙúwàa	'war'

The reduplicative forms in (23), *bátúttúkàa*, *zántúttúkàa*, and *ráafúffúkàa*, arise from *bát-úk-t-úkàa*, *zánt-úk-t-úkàa*, and *ráaf-úk-f-úkàa* by a rule assimilating consonants and glides totally to a following consonant or glide. If we undo this rule, it takes the reduplicative plurals in (23) back to the representations *bátúCtúkàa*, *zántúCtúkàa*, and *ráafúCfúkàa*. These can now have the effects of Reduplication (generalized below in (26)) removed, yielding *bát-úk-àa*, *zánt-úk-àa*, and *ráaf-úk-àa*. The resulting forms consist of the singular root and the ending *-úkàa*.

In the reduplicative plurals of (24), the sound *uu* is the syllable final reflex of *uw*. By undoing the rule *uw* → *uu* / ___ $, we obtain representations like *bát-úw-t-úwàa*, which can now have the effects of Reduplication removed. Undoing Reduplication yields forms like *bát-úw-àa*, consisting of the singular stem plus the ending *-úsàa*.

The word formation rule for *-únàa* in (17) may be extended to the *-úkàa* and *-úwàa* plurals in the following way:

(25) Class 5

$$\begin{array}{l}[\mathrm{QV}]_{\mathrm{sg.}}\\ \;1\,2\end{array} \Rightarrow \begin{array}{l}[\acute{\mathrm{Q}}\text{-}\\ \;1\end{array}\left\{\begin{array}{l}\textit{únàa}\\ \textit{úkàa}\\ \textit{úwàa}\end{array}\right\}]_{\mathrm{pl.}}$$

Similarly, the reduplication rule may be generalized. The following formulation will allow for the Class 5 reduplicatives along with others discussed in sections 4 and 5 below.

(26) Reduplication

$$\begin{array}{l}[\mathrm{X(C)C}]_{\mathrm{R}}\text{-VC-V}\\ \;1\;2\;3\quad\;\; 4\quad 5\end{array} \Rightarrow \begin{array}{l}[\mathrm{X(C)C}]_{\mathrm{R}}\text{-VC-C-VC-V}\\ \;1\;2\;3\quad\;\; 4\quad\; 3\;4\quad 5\end{array}$$

Because this account works back from the surface rather than the other way around, it is able to account directly for a plural like *máasúusúkàa* 'spears', which is a variant of *máasússúkàa*. In the latter form, the sequence *-sússúkàa* is readily interpreted as arising from *súC-súkàa* by the total consonant assimilation rule. But accounts proceeding from underlying forms to surface forms have difficulty explaining why in the alternate form *máasúusúkàa*, *uu* (from *uw*) rather than *us* (from *uk*) appears. In the present account, this is not a problem. The environment for undergoing total assimilation is not met by *máasúusúkàa*; instead, *uu* is interpreted as *uw*. Hausa has a rule, Klingenheben's Law (cf. Klingenheben 1928, Schuh 1972), converting syllable final labial and velar obstruents to *w* and syllable final alveolar and palatal consonants to *r*. By undoing the effects of Klingenheben's Law on *uw*, we take the *w* back to a representation designating any labial or velar obstruent. As a result, we can undo (26) Reduplication; the outcome is the representation *máas-úkàa* for the plural. The singular, *máas̃ìi*, must have the effect of palatalization subtracted from it, yielding *máasìi*, and now the singular and plural are relatable by rule (25).

This analysis can be extended one step further to account for a class of plurals that Parsons puts into Class 5 but which seem somewhat different superficially from the others of this class considered above. For Kano dialect, Parsons lists only three forms in this subclass:

(27)

Singular	*Plural*	
'áykìi	'áyúkàa	'work'
táfkìi	táfúkàa	'pond'
sárs'èe	sárús'àa	'splinter'

In these plurals, the final consonant of the root turns up before the ending *-àa* rather than before *-únàa*, *-úkàa*, or *-úwàa*, as we might have expected, and the vowel *ú* mysteriously appears before the root final consonants. These forms fall into line if we take the plural ending to be *-úwàa* and submit this ending to the undoing of *w* Epenthesis, which accounts for the placement of a *w* after a rounded vowel before a back vowel.[2] By undoing this rule, we convert *-úwàa* to *-ú-àa* in the word formation rule. All that is required now is a rule that relates the C in *-úCàa* in the plurals of (27) to the corresponding C of the stem:

(28) Infixation

$$\underset{1\,2\,3\quad 4\;\;5}{[[\mathrm{XCC}]_R\text{-V-V}]_{\mathrm{pl.}}} \Rightarrow \underset{1\,2\quad 4\;\;3\;\;5}{[[\mathrm{XC}]_R\text{-V-C-V}]_{\mathrm{pl.}}}$$

This rule will also operate in Class 1 plurals, described in section 5. These new rules will bring about the following type of derivation for the forms in (27).

(29)	W₁	W₂	Morphology
Lexical forms:	sárs’èe	sárús’àa	$\underset{1\,2}{[\mathrm{QV}]_{\mathrm{sg.}}} \Rightarrow \underset{1}{[\acute{\mathrm{Q}}\text{-}\acute{u}w\grave{a}a]_{\mathrm{pl.}}}$
a. $\emptyset \rightarrow w \,/\, \begin{bmatrix} \mathrm{V} \\ +\mathrm{rd} \end{bmatrix} \_\_\_ \begin{bmatrix} \mathrm{V} \\ +\mathrm{bk} \end{bmatrix}$	—	—	$\Rightarrow [\acute{\mathrm{Q}}\text{-}\acute{u}\text{-}\grave{a}a]_{\mathrm{pl.}}$
b. (28) Infixation	—	sárs’-ú-àa	

At stage (b) the relationship between W₁ and W₂ is declared valid; it is at this stage that the plural satisfies the condition on Q and exhibits the proper fòrm of the root and suffix.

It is hard to argue strongly for this extension of the analysis solely on the basis of the three examples in (27). But the fact that Class 1 plurals will require a parallel treatment, involving a good deal more cases than the three above, will strengthen its plausibility. In addition, this extension permits the analysis of another subclass of Class 5 plurals. These are:

(30)

	Singular	*Plural*	*Reduplicative Plural*	
a.	háatìmíi	háat-ú-m-àa		‘seal’
	tákòobíi	ták-ú-b-àa		‘sword’
	’àl’ámàríi	’ál’ám-ú-r-àa		‘affair’
	háràfíi	hár-ú-f-àa		‘letter of the alphabet’
	cóokàlíi	cóok-ú-l-àa		‘spoon’
	gàatáríi	gáat-ú-r-àa		‘axe’

---

[2] Cf. *bàaƙóo/bàaƙúwáa* (= **bàaƙóo-áa*) ‘male guest’/‘female guest’; *ƙáatòo/ƙáatùwáa* (= **ƙáatòo-áa*) ‘huge (m.)’/‘huge (f.)’. Compare: *béebée/béebìyáa* (= **béebèe-áa*) ‘male deaf-mute’/‘female deaf-mute’; *gàjéerée/gàjéerìyáa* (= **gàjéerèe-áa*) ‘short (m.)’/‘short (f.)’.

	Singular	*Plural*	*Reduplicative Plural*	
b.	máagànìi		máag-ú-n-gún-àa	'medicine'
	kábàríi		káb-ú-r-búr-àa	'grave'
	támbàríi		támb-ú-r-búr-àa	'kind of drum'
	háƙàr-ƙár-íi		háƙ-ú-r-ƙúr-àa	'rib'

These require one change in rule (28) to provide for the replacement of the last root vowel by the *ú* of suffix *-úwàa*.

(31) Infixation

$$\begin{array}{cccccccccccc}
[[X & C & (V) & C]_R & \text{-}V & \text{-}V]_{pl.} & \Rightarrow & [[X & C]_R & \text{-}V & \text{-}C & \text{-}V]_{pl.}\\
1 & 2 & 3 & 4 & 5 & 6 & & 1 & 2 & 5 & 4 & 6
\end{array}$$

This change does not affect the derivations illustrated previously since (V), term 3 in rule (31), is optional. The derivations below illustrate how the plurals in (30) are parsed.

(32)	W_1	W_2	Morphology
Lexical forms:	háatìmíi	háatúmàa	$[\underset{1}{Q}\underset{2}{V}]_{sg.} \Rightarrow [\underset{1}{\acute{Q}}\text{-}\textit{úwàa}]_{pl.}$
a. $\emptyset \rightarrow w \,/\, \begin{bmatrix}V\\+rd\end{bmatrix}\text{——}\begin{bmatrix}V\\+bk\end{bmatrix}$	—	—	$\Rightarrow [\underset{1}{\acute{Q}}\text{-}\textit{ú-àa}]_{pl.}$
b. (31) Infixation	—	háat(V)m-ú-àa	—

(33)	W_1	W_2	Morphology
Lexical forms:	máagànìi	máagúngúnàa	$[\underset{1}{Q}\underset{2}{V}]_{sg.} \Rightarrow [\underset{1}{\acute{Q}}\text{-}\textit{úwàa}]_{pl.}$
a. $\emptyset \rightarrow w \,/\, \begin{bmatrix}V\\+rd\end{bmatrix}\text{——}\begin{bmatrix}V\\+bk\end{bmatrix}$	—	—	$\Rightarrow [\underset{1}{\acute{Q}}\text{-}\textit{ú-àa}]_{pl..}$
b. (26) Reduplication	—	máag-ún-àa	—
c. (31) Infixation	—	máag(V)n-ú-àa	—

At stage (b) in (32) and at stage (c) in (33), the singular and plural are compatible with the morphological rule, and so the derivation is successfully completed. The only additional thing that must happen in the last example of (30b), *háƙàr-ƙár-ìi/háƙ-ú-r-ƙúr-àa*, is that reduplication must also be undone in the singular form; as a result, the abstract singular /háƙàríi/ will be found compatible with the abstract plural /háƙ(V)r-ú-àa/.

This concludes the analysis of Class 5 plurals. Their diversity has yielded to principles that apply consistently across the various subclasses. The analysis of Class 1 plurals in section 5 will help to show that the procedures applied above are not peculiar to the analysis of Class 5.

4. Reduplication in other plurals

A few plurals, which add *-(àk)ái* or *-(àk)íi* to the singular root, manifest some reduplicative forms.

(34)	*Singular*	*Plural*	*Reduplicative Plural*	
a.	góonáa	gòonàkái	—	'farm'
	góoròo	—	gòor-àr-ràk-ái	'kola nut'
b.	bírìi	bìrái	—	'monkey'
	líttáafìi	lìttàafái	lìttàt-tàaf-ái	'book'
(35)a.	góonáa	gòonàkíi	—	'farm'
	háwsá	—	háws-às-sák-íi	'language'
b.	bàaƙóo	bàaƙíi	—	'guest'
	gáddámàa	—	gáddàn-dám-íi	'dispute'

The word formation rule forms the plurals in (34) and (35) by adding the endings *-(àk)ái* and *-(àk)íi* to the singular root. For the reduplicative plurals, Consonant Assimilation and Vowel Shortening are first undone, along with Nasal Assimilation, which takes *gáddàn-dám-íi* back to *gáddà*$\left[\begin{smallmatrix}C\\+\text{nas}\end{smallmatrix}\right]$*-dám-íi*. Subsequently, Reduplication is undone, making them proper inputs to the plural formation rule. The tones of the reduplicative forms will be discussed in section 5, once the plurals *dúwàrwás'úu* 'stones' and *kúmàrmátúu* 'cheeks' are parsed.
Here is a sample derivation:

(36)	W_1	W_2	Morphology
Lexical forms:	líttáafìi	lìttàttàafái	$[\underset{1}{X}\underset{2}{V}]_{sg.} \Rightarrow [\underset{1}{\grave{X}}\text{-}(\grave{a}k)\text{-}\acute{a}i]_{pl.}$
a. C Assimilation	—	lìttà$\begin{bmatrix}C\\-\text{son}\\-\text{vd}\end{bmatrix}$tàafái	—
b. V Shortening	—	lìttàa$\begin{bmatrix}C\\-\text{son}\\-\text{vd}\end{bmatrix}$tàafái	—
c. Reduplication	—	lìttàaf-ái	—

5. Class 1 plurals

5.0. Class 1 has perhaps the most interesting plurals of all, since it displays a considerable amount of intricacy and has enough members to permit one to speculate fruitfully about what the important generalizations are. This class has already been analyzed by Newman, and, while I intend to propose some modifications of Newman's account, I believe that the basic outline of his proposal is essentially correct. In 5.1 I summarize Newman's analysis; after this I reformulate parts of it.

5.1. Class 1 plurals sometimes take a doubled consonant and sometimes fail to do so. Here are some typical singular/plural pairs.

(37)	*Singular*	*Plural*	
a.	káráa	káràarée	'corn stalk'
	ƙásáa	ƙásàašée	'land'
	dámóo	dámàamée	'land monitor'
b.	bírníi	bíràanée	'city'
	'áskáa	'ásàakée	'razor'
	fárkée	fátàakée	'itinerant trader'
	kúlkíi	kúlàakée	'cudgel'
	ƙyáwrée	ƙyáwàarée	'door covering'
c.	béebée	béebàayée	'deaf mute'
	ɓéeráa	ɓéeràayée	'rat'
	ɓáwrée	ɓáwràayée	'fig tree'
	gíndíi	gíndàayée	'hobbling rope'
	gámmóo	gámmàayée	'head pad'
	tállée	tállàayée	'small soup pot'

These plurals contain the infix *-àa-* and the suffix *-ée*. Only group (37a) has a double of the second root consonant between *-àa-* and *-ée-*, and the first syllable of the singular is light (CV̆).[3] The rule of Doubling, which copies the second consonant of the stem, must be conditioned to apply only to members of this category. Roots in (37b, c) begin with a heavy syllable (CVC or CV̄). In the clear cases (the first few examples in each group, representing the majority of nouns and adjectives that take plurals in Class 1), the plural ends in *-àayée* if the singular root contains a long vowel or a diphthong; but in *-àaCée* (where C represents the third consonant of the root or a double of the second root consonant) if the singular root is of the form CV̆CC- or CV̆C-. To account for this, Newman's infixation rule places *àa-* directly after the second consonant of the root. CV̄C roots thus have plurals of the form CV̄C-*àa-ée* (with epenthetic *y* separating *-àa* from *-ée*), while CV̆CC or CV̆C roots yield plurals of the form CVC-*àa*-C-*ée*.

There are examples above which do not easily conform to these rules. For instance, in (37b) *ƙyáwrée* looks as if the root contains a diphthong *aw* but behaves as if the *w* were a true consonant (contrast the behavior of the root with *aw* in group (37c), where *w* behaves like a glide). To handle this difference, Newman posits that the *w* in *ƙyáwrée* is [− vocalic], while the *w* in *ɓáwrée* is [+ vocalic]; alternatively, he might have proposed that the *w* in *ƙyáwrée* is [+consonantal], while the one in *ɓáwrée* is [−consonantal]. A better solution will emerge in the reanalysis in 5.2. Another apparent exception to Newman's otherwise quite attractive proposal involves the last three forms in (37c), which behave as if the singular root had a diphthong, though the singular actually has a vowel-nasal sequence. To bring these forms into line, Newman classifies Hausa syllable final nasals as [+vocalic] (and, presumably, as [−consonantal], to prevent them from counting as the second consonant of the stem for purposes of *-àa-* infixation) and takes the representation of *tállée* relevant for plural formation to be **tánlée*, where *n* is again [+vocalic].[4]

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[3] Parsons notes that *wáagáa/wáagàagée* 'basket for loading hides' is exceptional in that it takes a doubled consonant in the plural even though the singular begins with a heavy syllable; he also notes an exception that goes the other way: *rágóo* 'lazy' has the plural *rágàayée* instead of the expected **rágàagée*.

There are a number of principled objections to this treatment of cases that do not conform to the rules which count consonants. Newman's reconstructed form **tánlée* may be diachronically correct, but synchronically it is implausible, since there is no hint of an *n* in this word. The proposal to regard *n* in *gíndíi* and similar words as the equivalent of a glide is ad hoc. The classification of some instances of *w* as [+vocalic] and others as [−vocalic] is equally ad hoc and constitutes a clear case of the diacritic use of a phonological feature, which Kiparsky (1973) has persuasively argued against. Speakers of Hausa, as far as we can predict from cases attested in other languages, do not learn that *w* is [+vocalic] in *ɓáwrée* but [−vocalic] in *ƙyáwrée*. Rather they simply learn the corresponding plurals *ɓáwràayée* and *ƙyáwàarée*, and somehow they deal with the fact that these plurals are formed somewhat differently even though the canonical shapes of the corresponding singulars are similar; some accounts would label one of these plurals as exceptional, but the account I present below will not even have to go this far.

5.2. Having attempted for several years to frame an analysis that states the generalizations noted by Newman without raising the sorts of objections that his analysis does, I have come to the conclusion that there is no valid way to do this if we retain the assumption that plurals are synchronically derived from singulars and that any allomorphy they exhibit is attributable to the differential application of phonological rules to the same underlying stem, depending on whether that stem occurs in a singular or in a plural. On the other hand, as I will try to demonstrate, we may use essentially the same rules as Newman without manipulating the definitions of phonological features as long as we maintain that the lexicon contains the surface forms of Hausa singulars and plurals and that the role of the grammar is to capture the relationship of singular/plural pairs by working back to non-distinct phonological representations that abstract from surface differences, in accordance with the conventions in (1). With these assumptions it will also be possible to extend the analysis to cases that the standard framework could not handle.

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[4] For this latter case, Newman cannot simply regard Hausa syllable final *l* as [+vocalic] since by his criteria *l* counts as [−vocalic] in the (37b) pair *kúlkíi*/*kúlàakée*. However, parallel to the treatment of *w* in *ƙyáwrée* vs. *ɓáwrée*, Newman might just as well have allowed syllable final *l* to be either [+vocalic] or [−vocalic], depending on what happens in the plural.

Let us begin by formulating the plural rule for Class 1 on the basis of the most transparent examples, the ones in (37c), which attach *-àayée* to the singular root with no morphophonemic changes.

(38) Class 1

[QV]$_{sg.}$ ⇒ [Q-*àa-y-ée*]$_{pl.}$
1 2 1

In accordance with Newman's observation on the importance of syllable weight, this rule is formulated with the variable Q with the same restriction that applied in Class 5: in plurals, Q ends in a heavy syllable followed at least by a consonant.

The forms in (37c), along with some others, such as *ùngùlúu/ùngùlàayée* 'vulture', are parsed by this rule directly with no further operations. To relate the pairs in (37a, b), we first extract the *y* from *àa-y-ée* by undoing *y* Epenthesis, which has roughly the following form:

(39) *y* Epenthesis

Ø → *y* / V____V

Now we need a way to associate the consonants in the endings, which have the form *-àaCée* in (37a, b), with the roots. Recall the preliminary form of (28) Infixation:

(28) Infixation (preliminary)

[[XCC]$_{R}$-V-V]$_{pl}$ ⇒ [[XC]$_{R}$-V-C-V]$_{pl.}$
1 2 3 4 5 1 2 4 3 5

This rule has precisely the desired effect in (37a,b): it converts *kár-àa-r-ée* to *kár-r-àa-ée*, *bír-àa-n-ée* to *bírn-àa-ée*, etc. Having undergone this rule, the plurals in (37b) are now related to their corresponding singulars by rule (38). A sample derivation follows:

(40)	W$_1$	W$_2$	Morphology
Lexical forms:	bírníi	bíràanée	[QV]$_{sg.}$ ⇒ [Q-*àa-y-ée*]$_{pl.}$ 1 2 1
a. Ø → *y* /V____V	—	—	⇒ [Q-*àa-ée*]$_{pl.}$
b. (28) Infixation	—	bírn-àa-ée	—

Note how this account would deal with the distinction between *ƙyáwrée/ƙyáwàarée* from (37b) and *ɓáwrée/ɓáwràayée* from (37c). (37c) would be parsed on the surface with no phonological operations; (37b) cannot be parsed on the surface, since the plural ends in *-àarée* instead of *-àayée,* and so it undergoes a derivation containing stages (a) and (b) in (40), yielding *ƙyáwree/ƙyáw-r-àa-ée,* which conforms to the morphological rule. The grammar thus successfully captures the relationships between these two types of singular/plural pairs, and it correctly reflects the fact that, from a synchronic point of view, it is essentially arbitrary that one of these plurals should end in *-àayée* while the other ends in *-àarée* — i.e. there is nothing in the pronunciation of the two singulars *ƙyáwrée* and *ɓáwrée* that would lead one to expect their plurals to be realized differently.

The forms in (37a) proceed as in (40), and then all that remains is to undo the effects of the Doubling rule (41), which may be collapsed with the Doubling rule proposed for Class 5 in (19).

(41) Doubling

$$\begin{array}{ll} [\mathrm{C}\check{\mathrm{V}}\mathrm{C}]_{\mathrm{R}}\mathrm{aa\text{-}ee} & \Rightarrow [\mathrm{C}\check{\mathrm{V}}\mathrm{C}]_{\mathrm{R}}\text{-C-aa-ee} \\ 1\,2\,3\quad\ 4\quad 5 & \quad\ 1\,2\,3\quad 3\ \ 4\ \ 5 \end{array}$$

The (37a) forms meet the condition on Q before rule (41) is undone, and they meet the remaining conditions of the morphological rule (38) afterwards.

In some cases, the doubled consonant undergoes a morphophonemic change by virtue of being placed before the palatalizing vowel *ee*; e.g. the double of *s* from *ƙásáa* becomes *š* before *-ée*: *ƙás-àa-š-ée*. For these, we must first undo (8) Palatalization before applying rule (28). The derivation is illustrated in (42).[5]

(42)	W_1	W_2	Morphology
Lexical forms:	ƙásáa	ƙásàašée	[QV]$_{\text{sg.}}$ ⇒ [Q-*àa-y-ée*]$_{\text{pl.}}$ 1 2 1
a. Ø → *y* / V____V	—	—	⇒ [Q-*àa-ée*]$_{\text{pl.}}$
b. (8) Palatalization	—	ƙásàasée	—
c. (28) Infixation	—	ƙás-s-àa-ée	—
d. (41) Doubling	—	ƙás-àa-ée	—

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[5] At stage (b), undoing Palatalization takes *š* back to *s*. To validly perform this operation, we must satisfy condition (1c), which permits rules to apply only if they make W_1 and W_2 more compatible with the morphological rule. It is hard to see how this condition is satisfied at stage (b), since the Palatalization rule does not know that subsequently, undoing Doubling will remove the *s* obtained from *š* and thus make the representations of W_1 and W_2 more compatible. To deal with this situation, it may be necessary to revise condition (1c) or to recast the analysis. A possible amendment of (1c) would have neutralization rules undone whether or not they increased the compatibility of forms, as long as there was some point in

The rule formulated as (28) Infixation was revised in section 3 to permit the substitution of the infix vowel *ú* for a root vowel in (30), e.g. for *háatìmíi/háat-ú-m-àa* 'seal'. The revised form, (31) Infixation, does extra work in Class 1. It relates *kútúrúu/kútàarée* 'leper' in the following way:

(43)	W_1	W_2	Morphology
Lexical forms:	kútúrúu	kútàarée	$[\underset{1}{Q}\underset{2}{V}]_{\text{sg.}} \Rightarrow [\underset{1}{Q}\text{-}\textit{àa-y-ée}]_{\text{pl.}}$
a. $\varnothing \rightarrow y \,/\, V\_\_\_V$	—	—	$\Rightarrow [\underset{1}{Q}\text{-}\textit{àa-ée}]_{\text{pl.}}$
b. (31) Infixation	—	kút(V)r-àa-ée	—

This analysis does not capture the restriction noted by Newman whereby roots of the form CVNC-, where N is a nasal, take the plural CVNC-*àayée* and not CVN-*àa*-C-*ée*. It successfully parses plurals of the form CVNC-*àayée* but it does not rule out the unattested ones of the form CVN-*àa*-C-*ée*. However, there is reason to permit the grammar to do this, since in some rather similar plural paradigms, roots in CVNC- do have the infix *àa* placed between the final nasal and consonant. Examples of these paradigms appear in (44).

(44)	*Singular*	*Plural*	
a.	ƙárfèe	ƙáràafáa	'metal'
	dáns'èe	dámàas'áa	'forearm'
	gúnkìi	gúmàakáa	'fetish'
b.	múrfàa	múràafúu	'type of cooking place'
	dúus'èe	dúwàas'úu	'stone'
	kúncìi	kúmàatúu	'cheek'

Just as Class 5 plurals were classed together despite the choice between *-únàa*, *-úkàa*, and *-úwàa* as the suffix, the Class 1 plurals in (37) may be grouped with the forms in (44) under the extended word formation rule (45).

(45) Class 1

$$[\underset{1}{Q}\underset{2}{V}]_{\text{sg.}} \Rightarrow [\underset{1}{Q}\text{-àa-y-}\left\{\begin{matrix}\text{ée}\\ \text{áa}\\ \text{úu}\end{matrix}\right\}]_{\text{pl.}}$$

Recall that (30) listed some reduplicative plurals which replace the stem vowel with an infix. This also happens in Class 1.

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continuing the derivation. Correspondingly, (1b) would be modified to provide that undoing a neutralization rule of the form $A \rightarrow [-F] / X\_\_\_Y$ assigns $[\alpha F]$ to A rather than $[+F]$, as provided by the present conventions.

(46)

Singular	*Plural*	*Reduplicative Plural*	
dúus'èe	dúwàas'úu	dúwàrwás'úu	'stone'
kúncìi	kúmàatúu	kúmàrmátúu	'cheek'

As in (35), reduplicative forms have a tone difference in the two copies of the reduplicative syllable: the first syllable is low and the copy is high. I cannot explain how this difference developed, but by making the reduplication rule insensitive to tone, we can simply delete the reduplicated syllable even though it differs from its match in tone. To handle the fact that the reduplicated syllable in (46) is (inexplicably) short, we may analogously leave the reduplication rule insensitive to vowel length.

(47)

	W₁	W₂	Morphology
Lexical forms:	dúus'èe	dúwàrwás'úu	$[\text{QV}]_{\text{sg.}}$ ⇒ $[\text{Q-}\textit{àa-y-úu}]_{\text{pl.}}$ 1 2 1
a. Ø → *y* / V____V	—	—	⇒ $[\text{Q-}\textit{àa-úu}]_{\text{pl.}}$
b. V Shortening	—	dúwàarwás'úu	—
c. Klingenheben's Law	—	dúwàa$\begin{bmatrix}\text{C}\\ -\text{son}\\ +\text{cor}\end{bmatrix}$wás'úu	—
d. (26) Reduplication	—	dúw-àa-s'-úu	—
e. (29) Infixation	—	dúws'-àa-úu	—
f. *uw* → *uu* / ____$	dúws'èe	—	—

6. Conclusion

This completes the analysis. We may conclude with a brief assessment and a word of caution. This paper has aimed to analyze certain Hausa plurals in a way that captures speakers' intuitions about which singulars could correspond with which plurals. To the extent that this paper has captured the relevant intuitions by applying its assumed theoretical principles consistently, we can conclude that this analysis is successful. It would be tempting — but unsound — to jump from this conclusion to the conclusion that the analysis is correct. The proposals in this paper are based on a theory of phonological and morphological structure that remains to be tested against other languages and other kinds of data. Certainly, the present work supports this theory, since it illustrates that the theory provides measures which apply consistently and effectively across various Hausa plural classes and subclasses. This is a promising sign, though not a totally decisive one, even if we judge that no other theory thus far encountered could have succeeded as thoroughly as the present one. The clearest message that emerges from this work is the suggestion that it would be profitable to undertake investigations similar to this one in other languages and to search for supporting evidence from language change and psycholinguistics.

Abraham, R.C. 1959a. *The Language of the Hausa People.* London.

Abraham, R.C. 1959b. *Hausa Literature and the Hausa Sound System.* London.

Abraham, R.C. 1962. *Dictionary of the Hausa Language.* London.

Dunn, E.F. "Hausa plurals: a stratificational restatement". *Third Annual Conference on African Linguistics*, ed. E. Voeltz, 171-95. Bloomington, Ind.

Greenberg, J.H. 1941. "Some problems in Hausa phonology". *Language* 17.316-323.

Jackendoff, R. 1975. "Morphological and semantic regularities in the lexicon". *Language* 51.639-71.

Kiparsky, P. 1973. "Phonological representations". *Three Dimensions of Linguistic Theory*, ed. O. Fujimura, 5-56. Tokyo.

Klingenheben, A. 1928. "Die Silbenauslautgesetze des Hausa". *Zeitschrift für Eingeborenen-Sprachen* 18.272-297.

Kraft, C.H. and M.G. Kraft. 1973. *Introductory Hausa.* Berkeley.

Leben, W.R. and O.W. Robinson. 1975. "'Upside-down' phonology". Paper presented at the Fiftieth Annual Meeting of the Linguistic Society of America.

Newman, P. 1972. "Syllable weight as a phonological variable". *Studies in African Linguistics* 3.301-23.

Parsons, F.W. "Morphological (singular-plural) classes of disyllabic nouns in Hausa". (Manuscript).

Schuh, R.G. 1972. "Rule inversion in Chadic". *Studies in African Linguistics* 3.379-97.

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